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FOREST MANAGEMENT OF LOBLOLLY PINE IN DELAWARE, MARYLAND, AND VIRGINIA.

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LOBLOLLY PINE ADAPTED TO FOREST MANAGEMENT.

Forestry or forest management differs from ordinary lumbering in that when a mature stand of timber is cut provision is always made to secure a new crop of young seedlings—either by natural seeding or by sowing or planting—to take the place of the trees removed. It consists primarily in the growing of successive crops of timber on the same area. It includes also the care of immature stands, comprising chiefly improvement thinnings and protection from fire.

Loblolly pine is easily the leading tree for forest management in those portions of Maryland, Delaware, and Virginia where it grows naturally. The factors which combine to make it particularly suitable for commercial timber growing are: The ease with which it reproduces itself and forms pure, well-stocked stands; its rapid growth and the wide range of sites on which it will grow; the many uses to which its wood is adapted; the comparative cheapness of logging and milling the timber, and the good prices which its lumber commands. This bulletin aims to show the financial possibilities in growing loblolly pine in Maryland, Delaware, and Virginia and to describe the best methods of management. As a basis for the latter the silvicultural characteristics of the species are first discussed.

DISTRIBUTION AND IMPORTANCE.

The accompanying map (fig. 1) shows the botanical and commercial distribution of loblolly pine in Delaware, Maryland, and Virginia. The region to which this report applies is that covered by the botanical range of the species. In this region loblolly pine occurs naturally in some 60 counties, comprising an area of 21,100 square miles (13,500,000 acres). Table 1 [1] gives the total cut of lumber of all species and that of yellow pine in these counties in 1909, and an estimate of the proportion which loblolly formed of the yellow pine output.

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[1] Given in detail by counties in Table 22, Appendix B.

TABLE 1.—*Cut of lumber in 60 counties of Delaware, Maryland, and Virginia in 1909.*

State.	Cut of all species, M b. f.	Cut of yellow pine.		Proportion of yellow pine output cut from loblolly pine.
		M b. f.	Per cent of total.	
Delaware (2 counties; 135 square miles)	51,967	38,767	74.6	90 per cent loblolly.
Maryland (13 counties; 440 square miles)	143,540	97,975	68.2	80 per cent loblolly.
Virginia (45 counties; 1,250 square miles)	1,295,353	1,116,334	86.2	75 per cent loblolly.
Total (1,825 square miles)	1,490,860	1,253,076	84.1	

As seen from the table, yellow pine forms the bulk of the lumber output, and is in turn composed chiefly of loblolly.

FOREST TYPES.

Loblolly pine occurs, even in the same locality, in a number of forest types arising from differences in physiography and soil. Five-sixths of the region, including all of the Maryland and Delaware portions and the larger part of the area in Virginia, lies in the comparatively flat coastal plains or "tidewater" region, with an average elevation of about 100 feet above sea, and containing much wet, poorly drained land. The remaining one-sixth is in the eastern part of the well-drained rolling hill country or Piedmont section of middle Virginia, with an elevation varying from 100 to 500 feet. The soils in the Coastal Plain section are generally light, while those in the Piedmont are heavy.

COASTAL PLAIN TYPES.

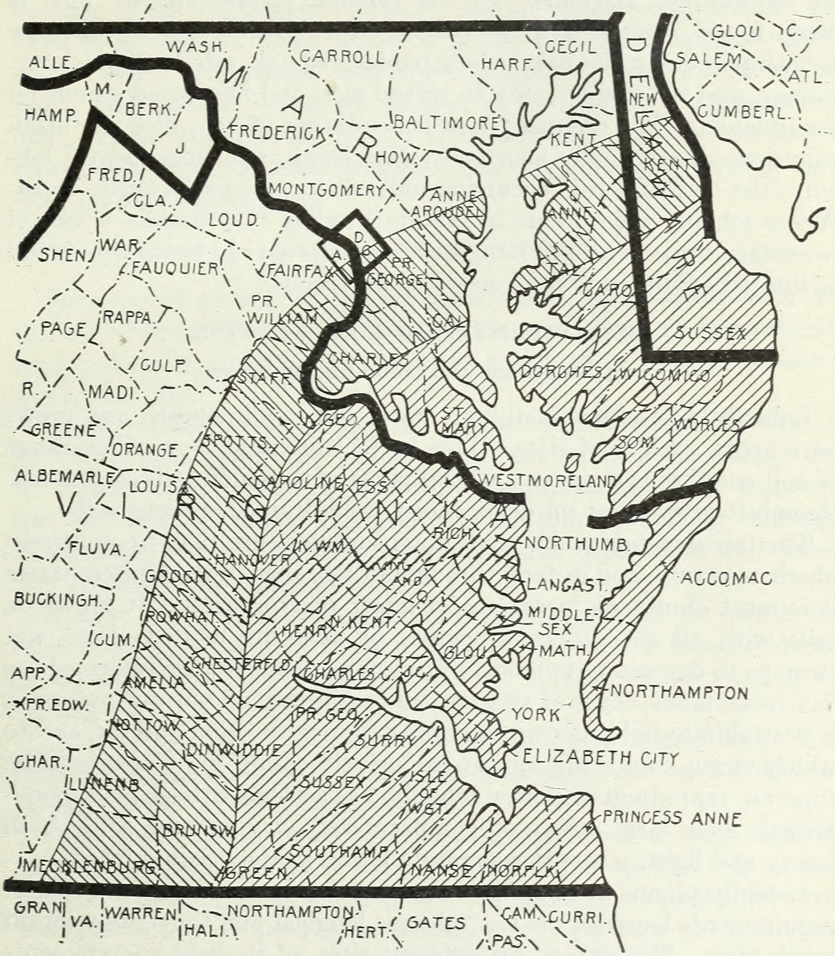
In the tidewater section loblolly pine grows:

(1) In pure stands; (*a*) on old fields, where most of the pure stands of any extent are found; (*b*) on moist soils along the edges of swamps, streams, and ponds, usually in comparatively small groups.

(2) In mixture with other species in swamps or semiswamps; (*a*) with cypress, gum, and maple on very wet land subject to overflow; (*b*) with maple, gum, several species of oak, and yellow poplar on moist to wet land not subject to inundation.

(3) On well-drained or upland soils in mixture with oaks, hickory, cedar, and gum, and shortleaf, scrub, and pitch pines.

In the Virginia tidewater section, covering some 11,000 square miles (7,000,000 acres), loblolly is the only species of pine occurring to any extent in commercial quantities, and is the important timber tree. In the northern half of the Maryland-Delaware Coastal Plain section loblolly is comparatively scarce, growing in mixture with hardwoods and some scrub and pitch pine, and is not important commercially. In the southern half of this region, however, where the general elevation is less than 50 feet above sea, loblolly is the most important timber tree.



▨ Regions of commercial importance. ▨ Limits of botanical distribution.

FIG. 1.—Distribution of loblolly pine in Maryland, Delaware, and Virginia.

PIEDMONT TYPES.

In middle or Piedmont Virginia, in the portion contiguous to the western edge of the Coastal Plain region, from Fredericksburg south, loblolly pine occurs in the following types:

(1) In pure pine stands (chiefly on old fields) in mixture with shortleaf and scrub pines. Shortleaf usually predominates, though

on lower slopes loblolly sometimes does. Westward from the eastern edge of the Piedmont, loblolly is gradually displaced by shortleaf and scrub pine, until the western limits of its botanical distribution are reached. (See map, fig. 1.)

(2) (*a*) In mixed pine and hardwood stands on lower slopes and on well-drained bottoms. In the original forests loblolly pine is rarely found, even as stray individual trees. The forests of this type are composed of white oak, yellow poplar, red oak, ash, birch, hickory, walnut, and red maple. (*b*) In mixed pine and hardwood stands on the uplands. The original forest is a mixture of oak, hickory, black gum and pine—usually shortleaf, some scrub, and infrequently loblolly, the last as a rule occurring only where the soil is fairly moist. Where loblolly pine occurs in middle Virginia it is usually a tree of secondary importance, although occasionally on old fields it is found to limited extent in pure or nearly pure stands.

CHARACTERISTICS OF LOBLOLLY PINE.

SOIL, MOISTURE, AND LIGHT REQUIREMENTS.

Loblolly pine is not fastidious in its soil requirements, and grows on a great variety of sites. It is in fact adapted to a wider range of soil conditions than any of the pines with which it is associated, though it grows best on deep, moist, well-drained, porous soils.

The tree depends much more upon soil moisture than upon atmospheric moisture, and in fact throughout its range in the United States it is most abundant in regions of lesser precipitation. It grows on soils with all the different degrees of moisture content from wet swamps to dry sandy uplands. It prefers, however, the intermediate flat, moist lands, edges of swamps, and well-drained bottoms, where it is best able to hold its own in competition with other species, and to which virgin stands are almost exclusively confined. Because of its superior reproductive power loblolly has extended itself as second-growth over large areas of comparatively dry upland soils, both heavy and light, where it was rarely found in the original forest.

Loblolly pine is intolerant of shade, being intermediate in its light requirements between the less tolerant longleaf and the more tolerant scrub pine. The effects, on different sites, of its light requirements upon reproduction and the development of individual trees and of stands are discussed later.

FORM AND DEVELOPMENT.

Under favorable forest conditions, with plenty of overhead light but shaded on the sides, loblolly pine develops, by the time it is 50 to 100 years old, a long, straight, cylindrical bole, clear of limbs for from 50 to 75 feet, with a diameter of from 15 to 24 inches breast-high and a height of from 80 to 120 feet. During the period of rapid height growth, which continues until the tree is about 40 years old, loblolly pine has a long, broad, conical or ovoid crown. With increasing age this gradually dies off at the bottom, and finally becomes somewhat flat and irregular.

In comparatively dense stands loblolly pine prunes itself rapidly, because of its intolerance of shade, and develops long, straight and clear boles which produce lumber of the best grades. In open stands, on the other hand, large, wide-spreading lateral branches are developed, and knotty, low-grade lumber is the result. Comparatively open stands characterize the dry soils, on which natural thinning is more rapid and the trees produced are shorter and less clean-boled than on moist situations.

GROWTH AND YIELD PER ACRE.

The rate of growth of loblolly pine varies considerably with the quality of the soil. The different soils or sites on which it commonly occurs may be conveniently grouped under three quality classes—I, II, and III.

Quality Class I comprises the richest soils, where the rate of growth is most rapid. It includes the very fertile soils, usually rich in organic matter, with a uniformly abundant supply of moisture, but free from standing water, such as bottom land along the edges of streams, ponds, and deep swamps, moist depressions and basins and the very best old-field soils.

Quality Class II includes the great bulk of soils on which the species occurs. These are fairly moist and are found in broad stretches of flat land between the bottoms and the uplands and in most of the old fields.

Quality Class III includes all poor and dry upland soils, both heavy and light, dry and sandy flat-land soils and sand hillls, and the poorest of wornout old-field land.

Old growth loblolly trees occur almost exclusively as single individuals or in small groups in mixture with other species. In second growth following clean cutting and on abandoned fields, however the species has a remarkable tendency to reproduce itself in pure, even-aged, fully stocked stands. Table 2 indicates the rate of growth of such stands and the trees composing them on the three qualities of soil described, including the possbile yield in either cubic feet or board feet at different ages. The cubic-foot yields are given for trees 3 inches in diameter and over, either peeled or with the bark on. The board-foot yields, which, of course, are not in addition to the cubic-foot yields, but merely express the yield for the same stand in another unit, apply when either all trees over 5 inches or all over 7 inches in diameter are counted. This table is based on measurements taken of pure, even-aged, unmanaged, fully stocked stands, found chiefly on old fields, and is a conservative indication of the possible yields from properly managed stands.

TABLE 2.—*Rate of growth and yield of pure, even-aged, fully stocked, unmanaged stands of loblolly pine in Somerset and Worcester Counties, Md.*

QUALITY I.

Age.	Trees per acre.		Average height of predominant[1] trees.	Average diameter breasthigh.		Yield per acre.			
	Dominant.	Total.		Dominant trees.	All trees.	Trees 3 inches and over in diameter (peeled).	Trees 3 inches and over in diameter (with bark).	Trees 5 inches and over in diameter.	Trees 7 inches and over in diameter.
Years.	*No.*	*No.*	*Feet.*	*Inches.*	*Inches.*	*Cu. ft.*	*Cu. ft.*	*Bd. ft.*	*Bd. ft.*
10	1,051	1,403	27	3.8	3.5	1,020	1,600	1,200	....
15	742	1,071	44	5.4	4.8	1,610	2,390	4,700	1,400
20	540	827	55	6.8	6.0	2,250	3,200	8,300	5,200
25	411	611	63	8.1	7.1	2,900	4,000	12,100	9,900
30	343	469	69	9.1	8.2	3,570	4,780	15,900	14,600
35	290	387	74	10.1	9.1	4,230	5,570	19,700	19,100
40	253	325	78	11.0	10.0	4,920	6,380	23,800	23,800
45	223	278	83	11.9	10.9	5,620	7,200	28,100	28,100
50	201	244	87	12.7	11.7	6,350	8,050	32,600	32,600
QUALITY II.									
10	1,095	1,518	21	3.4	3.2	670	1,070	400	....
15	738	1,099	34	4.8	4.3	1,110	1,680	2,800	800
20	527	758	44	6.1	5.5	1,600	2,320	5,400	3,000
25	381	587	51	7.4	6.5	2,140	3,000	8,100	6,200
30	293	475	57	8.6	7.4	2,700	3,690	11,000	9,400
35	241	413	62	9.6	8.1	3,270	4,390	13,800	12,400
40	210	385	66	10.4	8.6	3,840	5,100	16,600	15,400
45	189	354	70	11.1	9.1	4,430	5,830	19,500	18,700
50	174	344	73	11.7	9.4	5,040	6,600	22,600	22,600
QUALITY III.									
10	576	827	15	3.3	3.1	340	550	....	....
15	656	1,089	25	4.2	3.8	630	980	1,300	200
20	625	1,075	33	5.0	4.4	960	1,460	2,800	900
25	538	894	40	5.8	5.1	1,360	2,000	4,400	2,100
30	480	751	46	6.4	5.7	1,790	2,580	6,000	3,500
35	407	610	50	7.1	6.4	2,280	3,200	7,700	5,500
40	353	517	54	7.7	7.0	2,770	3,820	9,400	7,600
45	309	441	57	8.3	7.6	3,290	4,480	11,300	10,200
50	280	381	60	8.8	8.2	3,860	5,180	13,400	13,400

[1] Predominant trees are considered to be those composing a group of the largest dominant trees, the basal area of the group being equal to one-third of the basal area of all the dominant trees.

REPRODUCTION.

In ability to reproduce itself loblolly is one of the best, if not the best, of any of the pines in the eastern United States.

SEED PRODUCTION AND DISSEMINATION.

In comparison with other species of pine loblolly is very prolific in seed production. Some seed is produced every year, but the amount varies considerably. Heavy seed years occur at intervals of from 3 to 5 years. In some years hardly sufficient seed is produced to give adequate reproduction. Loblolly takes two seasons to ripen its cones, and because of this the relative amount of seed which will be produced can be foretold a year in advance. The amount of seed produced by any one tree varies normally with its age, size, and amount of growing space. The best seeders are trees 40 or more years old, or which have about completed their principal height growth and which have comparatively isolated crowns and an ample growing space. Trees in crowded stands do not seed so prolifically as trees growing in the open.

The seed falls in late autumn and through the winter and early spring. It is disseminated chiefly by the wind. Trees with many cones will scatter seeds very plentifully to a distance of twice their own height in the direction of the prevailing winter winds. In general loblolly pine can be relied upon for thickly stocking in one season unobstructed areas adjacent to seed trees for a distance of 100 feet to 100 yards, according to the height of the trees and provided it is a good seed year and there is a suitable seed bed.

Seed-bed Requirements.

For germination loblolly pine seed is comparatively independent of seed bed and soil conditions. The seed requires only a slight degree of moisture to cause it to germinate. For seedling establishment and growth following germination the seed-bed requirements of loblolly vary with the moisture content of the soil. On fresh to dry soils the seedling demands an open seed bed—that is, with plenty of light and little or no overhead crown cover and the soil exposed, or nearly so, with no layer of leaves and litter to prevent the developing roots from immediately coming in contact with the soil. On moist to wet sites, on the other hand, the seedling is able to exist and develop under considerable shade on comparatively thick layers of undecomposed pine needles and litter.

The most favorable conditions for loblolly reproduction are, in general, found in the open on an exposed loose soil, into which the roots of the seedling can at once enter and where the crown has plenty of light. Where loblolly pine seed trees occur in the vicinity of unused fields the land very quickly becomes seeded up to pine. Loblolly reproduction also takes place readily on a cover of grass, provided it does not form a compact sod. It seeds well on areas covered with tall grass, such as broom grass, which may come in after the forest is cleared.

On dry sites in the forest with a thick layer of undecomposed leaf litter there is little chance for reproduction of loblolly because of inadequate moisture, but on moist to wet situations reproduction usually takes place in spite of any impeding forest floor. On dry sites the seedling requires a good deal more light for its development or existence even than on moist to wet situations, which is one of the main reasons for the lack of loblolly reproduction under the shade of large trees, where the soil is not moist. For this reason lumbering as a rule improves the seed-bed conditions for loblolly pine and increases its reproduction, provided seed trees of the species are left. The abundance of direct sunlight let in by cutting of the forest also causes the impeding forest floor to decompose rapidly, so that the roots of the seedlings can more readily reach the soil. Another great hindrance to germination and growth of loblolly-pine seed which falls after lumbering, in addition to that of a thick undecomposed forest floor, is a luxuriant growth of ground cover and underbrush, including hardwood sprouts and seedlings, which in places may be so dense as to preclude pine reproduction entirely.

Seedling Development.

The growth in height of loblolly seedlings for the first two years is slow, but during this period there is vigorous root development. Under average conditions seedlings in the open reach a height of from 2 to 6 inches the first and from 6 to 12 inches the second season. After this there sets in a rapid height growth of from 1 to 3 feet a year, which continues for from 30 to 50 years before beginning to fall off.

SUSCEPTIBILITY TO INJURY.

Wind.

Loblolly pine is usually windfirm, since it grows mainly on soils conducive to the development of a deep taproot with strong laterals. It is only where there is an impenetrable subsoil that it develops a shallow, flat root system and is easily wind-thrown. It seldom suffers much damage from windbreak, and where broken off will usually show that it has first been killed or weakened by fire, insects, or fungi.

Fire.

The thick bark of loblolly pine gives it unusually good protection from damage by surface fires. Table 3 shows the average thickness of bark for trees of different diameters and heights 20 to 50 years old, which indicates their relative susceptibility to damage.

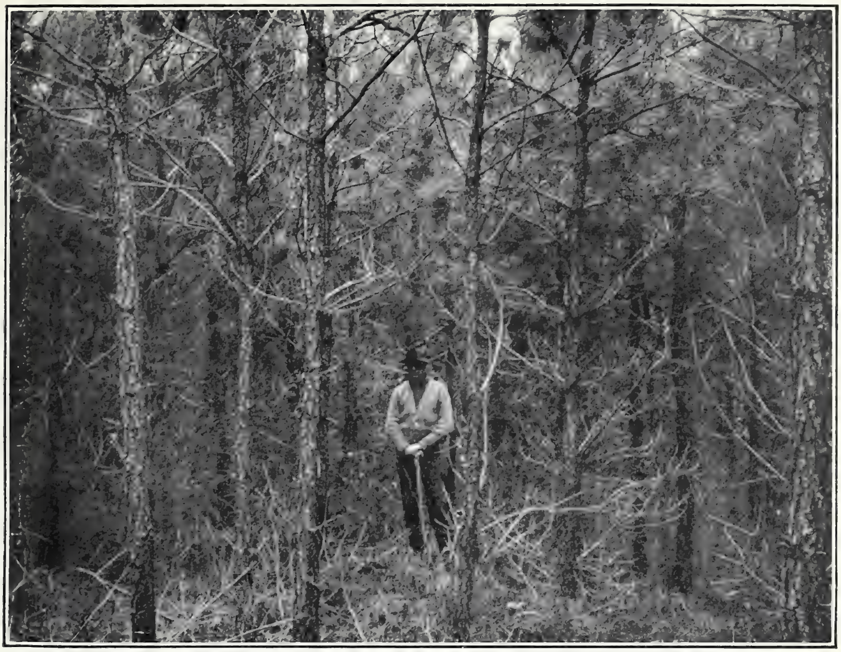


FIG. 1.—DENSE 8-YEAR-OLD STAND ON COMPARATIVELY MOIST SITE.

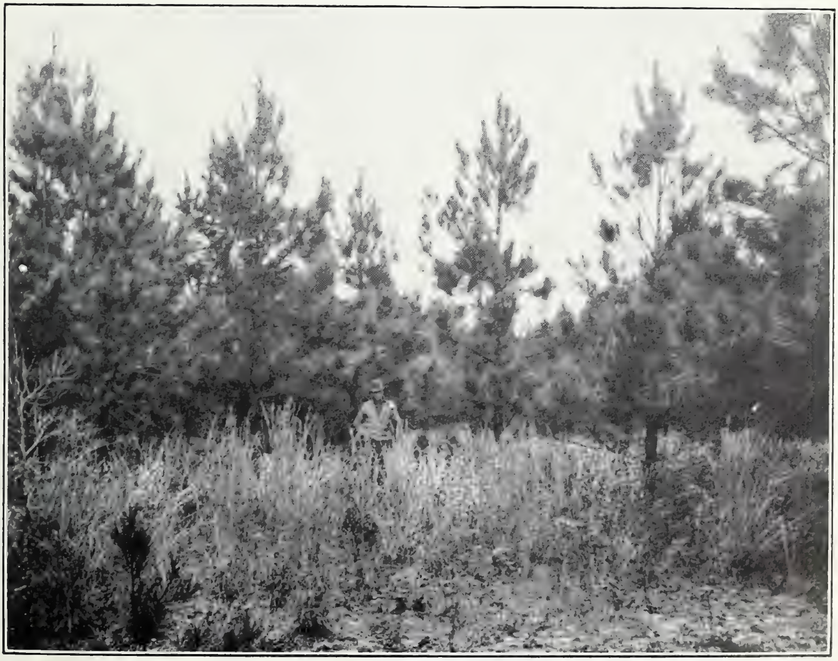


FIG. 2.—OPEN STAND OF SAME AGE ON VERY DRY SANDY SITE A FEW FEET AWAY.

EFFECT OF MOISTURE ON DENSITY OF STAND.

TABLE 3.—*Average thickness of bark at 4.5 feet from the ground for trees of different diameters and heights, from 20 to 50 years in age, Somerset and Worcester Counties, Md.*

[Table based on taper curves.]

Diameter breast-high.	Height of tree (feet).					
	30	40	50	60	70	80
	Double width of bark at breastheight.					
Inches.	*Ins.*	*Ins.*	*Ins.*	*Ins.*	*Ins.*	*Ins.*
3	0.5	0.7	......	......	......	......
4	.7	.8	0.9	......	......	......
5	.9	.9	1.0	......	......	......
6	1.0	1.0	1.1	1.1	......	......
7	1.1	1.2	1.2	1.2	......	......
8	1.3	1.3	1.3	1.3	1.2	......
9	......	1.5	1.4	1.3	1.2	......
10	......	1.6	1.5	1.4	1.3	1.2
11	......	......	1.6	1.5	1.3	1.2
12	......	......	1.7	1.6	1.4	1.3
13	......	......	1.8	1.7	1.5	1.4
14	......	......	......	1.9	1.6	1.5
15	......	......	......	1.9	1.7	1.5
16	......	......	......	2.1	1.9	1.6
17	......	......	......	......	2.0	1.7
18	......	......	......	......	2.1	1.9
19	......	......	......	......	......	2.0
20	......	......	......	......	......	2.1

By far the most common form of fire in loblolly pine is the surface fire. The damage to any particular stand varies with the severity of the fire and the age and size of the trees. In general, the older the stand and the larger the trees the less will the damage be. Even a light surface fire in a sapling stand under 6 years of age usually kills a large part if not all of the trees outright, while in an older stand such a fire would kill few or none of the trees. Fires in sapling stands are especially destructive because they are likely to spread to the tops. Crown fires in loblolly pine, however, are limited almost entirely to the younger sapling stands, because of the rapidity with which older trees prune themselves of lateral branches for a considerable distance above the ground. The most destructive and costly form of fire in loblolly pine is a combination of surface and ground or subsurface fire, such as occurs at very dry times in bottoms and swamps where there is a deep accumulation of partially decomposed vegetable matter. Such fires kill the largest trees as well as the smallest.

The severity of forest fires and the consequent damage varies with a number of factors, among them the amount and relative dryness of inflammable material, such as leaf litter, débris, and underbrush, the velocity of the wind, and the moisture content of the atmosphere. Stands on low, wet sites are less subject to damage by fire than those on dry situations.

It is a common practice of some lumber companies in the South to burn over the forest every one to three years to prevent the accumulation of inflammable material. Large areas of forest land in the South are also burned over annually to improve the grazing, which also prevents severe fires. This is a cheap and effective method of insuring protection to valuable mature standing timber, but is extremely harmful to young stands. Forest fires of any kind are always injurious. Even if they do not kill the trees outright, they impair their vitality, lessen the rate of growth, and render them more susceptible to fatal attacks of destructive insects.

INSECTS.

The only insect enemy of loblolly pine to cause any serious damage in recent years is the southern pine beetle (*Dendroctonus frontalis*). It is important that this insect be watched for in stands under management. Whenever detected, steps should at once be taken to keep it under control. Apparently at long intervals, frequently of 20 years, it becomes so abundant as to cause widespread destruction of pine timber, a loss which could be averted in stands under management by proper precautions. The depredations frequently last several years unless measures are taken to control the insects. Other species of insects often follow in the wake of the Dendroctonus and feed on trees weakened or killed by its attacks. Sometimes they even attack and kill healthy uninfested trees in the same locality. But with the disappearance of the Dendroctonus in any particular locality the other species of beetles disappear also. This does not seem to be due so much to the measures taken to control the Dendroctonus as to the fact that these other insects are unable effectively to attack live pine timber unaided. However, though the southern pine beetle is the only insect causing serious damage to southern pines at present, it is possible that other species might sometimes become sufficiently numerous to cause extensive destruction.[1]

Whenever owners of loblolly-pine forests discover their timber to be dying in small patches and are unable to determine the cause, they should at once communicate with the Bureau of Entomology, U. S. Department of Agriculture.

DISEASES.

The principal disease to which loblolly pine is subject is that which causes red heart. Mycelia (spawn) of large polyporous fungi infest the woody tissue of the living tree, the hyphæ (filaments) of the spawn destroying the walls of the wood cells, causing the wood to assume a reddish color and rendering it very brittle. Red heart is very rare in young loblolly pine—that is, under 75 years of age—but is quite common in old-growth trees from 150 to 200 years old. From the standpoint of future forest management this disease does not need to be considered, since future stands will be grown almost exclusively on short rotations of less than 75 years. The red heart grades (culls) of North Carolina pine lumber, provided for by the grading rules of the North Carolina Pine Association, will be of no importance after the old-growth timber is cut.

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[1] For a complete discussion of how to detect insect injury by the southern pine beetle and methods of controlling infestations the reader is referred to Farmers' Bulletin 476, U. S. Department of Agriculture, by Dr. A. D. Hopkins, in charge of Forest Insect Investigations, Bureau of Entomology. Everyone managing loblolly pine forests should secure this bulletin. During 1910 and 1911 the Dendroctonus destroyed a considerable amount of pine timber in the South, though the insect has now been largely brought under control wherever owners of pine tracts have carried out the measures recommended in the publication.

UTILIZATION.[1]

USES.[2]

Both the use and value of loblolly pine lumber have increased since the custom of seasoning it in dry kilns became common. Prior to that time loblolly lumber frequently went to the market green or imperfectly seasoned. It is largely sapwood, especially in small and medium-sized trees, and the water in it made it susceptible to attack by fungi, which gave a blue color to the wood, and not only marred its appearance but induced deterioration. Thorough drying in kilns removed the cause for that objection, and loblolly speedily won an important place in the market. Its range of uses is wide, and it is sold throughout the eastern and central United States and exported to Europe and Central America.

The principal uses to which loblolly pine is put are: For building lumber, such as interior finish, flooring, ceiling, frames and sashes, wainscoting, weather boarding, joists, lath, and shingles; for boxes and packages, in the form of boards and veneers, and in the manufacture of slack barrels; in the manufacture of cheap furniture, woodenware, toys, etc.; for construction purposes, in bridge and trestle work, in heavy building operations where the conditions are not such as to require longleaf, and in car construction, chiefly for freight cars. Much loblolly pine is cut for crossties, for which it is well suited after being given a preservative treatment. It is among the most easily treated timbers in the United States, and the recent developments in wood impregnation processes and plants is rapidly increasing its use for many purposes. It is extensively used for mine props in the South and in Pennsylvania, frequently after being given a preservative treatment. Few pines if any exceed loblolly in use for fuel. Immense quantities are shipped as cordwood for domestic purposes, and find markets in towns in the loblolly region and in cities as far north as Philadelphia. Its use for fuel purposes in manufacturing is also extremely large, particularly in brick burning, pottery kilns, and by bakers who demand a quick, hot fire.

A report of the woods used in Maryland for manufacturing purposes in 1909 [3] shows loblolly as exceeding all other woods combined (17 species were used) in the manufacture of boxes and crates, and as standing second in cooperage and basket making. Among the many commodities of which it forms all or a part of the material are basket bottoms, vegetable crates, nail kegs, and boxes for fruits, vegetables, and bottles. It has a regular place in vehicle manufacturing for beds and bodies for wagons and carts, and in boat building for masts, siding, decking, lining, ceiling, cabins, and all kinds of finish and joiner work in skiffs, yachts, motor boats, and sailing craft. It is widely used by slack coopers. It is standard material for interior finish, and is frequently employed on an equal footing with long-leaf pine, which it closely resembles if carefully selected with regard to grain. It takes finish well, and if painted, as it usually is when used as weatherboarding, it wears well and needs repainting only at long intervals. It makes excellent flooring, and serves for practically all kinds of interior finish—window and door frames, ceiling, wainscoting, molding, railing, balusters, brackets, and stair work. Cabinetmakers work it into many articles, and it is seen in wardrobes, clothespresses, shelving, drawers, compartments, and boxes. It has no less a range of uses in furniture making, going for the most part into frames for couches, lounges, and large chairs.

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[1] For characteristics of the wood see Appendix C.

[2] Based on pp. 22–24, Bulletin 99 of the Forest Service, "Uses of Commercial Woods of the United States: Pines."

[3] The latest available figures.

A report of the wood-using industries of North Carolina (where conditions are like those in Virginia), in 1909, showed the position of loblolly pine to be similar to that in Maryland. In North Carolina more of it was used than of all other woods combined, the total being considerably more than 300 million feet. Practically every industry of the State that employed wood in manufacturing gave a prominent place to loblolly pine. Nearly 3,000,000 feet were used for telephone cross arms, it being practically the only wood employed for that purpose in the region. A comparatively large use in North Carolina is for tobacco hogsheads. Also, most of the matched flooring manufactured in that State was from loblolly.

There are a number of possible ways [1] of profitably utilizing loblolly pine material which at present it is not possible or will not pay to turn into lumber. Among these are the manufacture of wood pulp and paper, the manufacture of ethyl alcohol in certain forms of wood distillation, and for the production of power by means of gas producers, which gives five times as much heat per cord as does the ordinary method of wood burning.

Experiments have shown that it is possible to manufacture an excellent grade of unbleached chemical pulp from yellow pine. This is the kind of pulp which at present is imported in large quantities from Europe, the amount in 1910 being 374,576,000 pounds, valued at $5,831,000.

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[1] See article by McGarvey Cline, written while Director Forest Products Laboratory, in the Southern Lumber Journal, Mar. 1, 1912, on "The Possible Utilization of Yellow Pine Stumpage."

Pine slabs as well as small logs and top logs can readily be converted into a high-grade chemical pulp, and if such material can be delivered to a suitably located paper mill, at the low price that seems possible in certain localities, it is practically certain that the Southern States could produce certain grades of paper in competition with the world.

PRESENT LUMBER PRICES.

The price received for loblolly pine lumber in the region covered by this report varies according as it is sold mill-run, either air-dried or green (principally to the local trade), or is kiln-dried, graded, and sold as North Carolina pine to the general lumber trade.

In the Delaware-Maryland-Virginia peninsula and on the western shore of Maryland practically the entire cut is sold locally mill-run and air-dried or green. Table 4 gives the average prices [1] received for loblolly pine lumber on the peninsula f. o. b. railroad or at factories and mills along the railroad.

TABLE 4.—*Prices of loblolly pine lumber in the Delaware-Maryland-Virginia Peninsula.*

	Per thousand.
1 inch thick, square-edge boards	$13.50
Small-dimension stuff	12.00
¾-inch thick board (for box factories)	11.50
Crate flitch [2]	10.00
Mine props [3] not sawed into lumber (in the round, and 11 to 17 inches in diameter in the middle of log)	12.00 to 15.00
Cull mine props [4] (less than 11 inches middle diameter)	7.00 to 8.75

Throughout the mainland of Virginia by far the larger part of the loblolly pine lumber output, after being kiln-dried and graded, is sold to the general lumber trade as North Carolina pine, or else is air-dried and graded as Virginia pine. Table 5 gives recent prices paid by wholesale merchants to manufacturers for the principal grades of North Carolina pine rough lumber, f. o. b. Norfolk, the main distributing center for this lumber.

TABLE 5.—*Prices of North Carolina pine f. o. b. Norfolk, Va. (basis actual sales).*[5]

Grade.	Average quarterly prices for quarter ending—						
	Dec. 31, 1912.	Sept. 30, 1912.	June 30, 1912.	Mar. 31, 1912.	Dec. 31, 1911.	Sept. 30, 1911.	June 30, 1911.
Under 12″ width:							
No. 1	$27.52	$25.75	$25.25	$25.00	$24.25	$24.25	$24.50
No. 2			23.00				
No. 3			17.25				
No. 4	16.99	15.75	15.25	15.25	13.50	12.75	12.50
1 and 2 bark strips			18.25				
Box bark strips			10.50				

[1] March, 1912.

[2] Logs (not suitable to cut into boards), especially small, crooked logs, are slabbed on three sides and cut into "flitch" 2″, 2½″, or 3″ in thickness, with variable widths on either face in each piece and scaled on the basis of the average width.

[3] Mine props sell at $3 a ton, green, f. o. b. railroad. It takes from 4 to 5 tons, or 8,000 to 10,000 pounds, of green mine props to cut out 1,000 board feet of 4/4 edge lumber, so that the price of $3 per ton amounts to $12 or $15 per thousand board feet.

[4] Cull mine props sell for $1.75 per ton, green, or $7 to $8.75 per thousand. The cost, figured in 1,000 board feet, of hauling green mine props amounts to about four times that of dry lumber, and for this reason props are cut only within a short haul of from 1 to 2 miles of the railroad.

[5] Selling price of wholesalers to retailers would be higher than the above prices.

COST OF LUMBER PRODUCTION.

In most of the region covered by this report the logs are cut by small portable or semiportable mills. The large mills are limited to the southeastern corner of Virginia, but even these are now securing the bulk of their logs by rail or water from North and South Carolina, as the supply in Virginia is largely cut out. In the future there will be only small mills which can be cheaply moved so as to saw up profitably isolated lots containing as little as 100,000 feet of standing timber. These, therefore, will deserve chief consideration in the management of loblolly-pine forests.

The cost of producing lumber, from the stump to the railroad or to a local market, exclusive of price paid for standing timber or stumpage, includes the following items where the milling is done by portable mills located in or near the timber: (1) Cutting and logging to the mill; (2) milling, including sawing and "sticking up;" (3) hauling lumber to the railroad or factory, including loading and unloading; (4) contractor's profit. For large mills located on the railroad there is in place of the hauling item a small charge for loading on the cars, and the cost item of logging to the mill is always considerably higher.

COST EXCLUSIVE OF HAULING.

The cost of producing loblolly pine lumber by small mills in the region, exclusive of hauling, is about as follows:

TABLE 6.—*Cost of lumbering (except hauling) per thousand board feet.*

	Minimum.	Average.	Maximum.
Cutting	$0.50	$0.75	$1.00
Skidding or hauling logs to mill	1.50	1.75	2.00
Sawing and "sticking up"	2.00	2.50	3.00
Contractor's profit	.50	1.00	1.50
Total (except hauling)	4.50	6.00	7.50

HAULING.

The cost of hauling is the most variable factor in the cost of lumber production by small mills, the variation being due to distance of mill from the railroad or local market, as well as to cost of team. A team of three horses (or mules) with driver can haul readily under present average road conditions in the region 2,000 feet of loblolly pine lumber a distance of 8 miles and return the same day, at an average speed of 2 miles an hour for the round trip. The cost of such a team in the region varies from $5 to $7 per day, depending largely on the season of the year. It is the custom for two such teams to work together, so that the two drivers can help each other in loading and unloading and in case either of the teams becomes stalled. It takes about an hour to load and unload a wagon. When more than one trip a day is made, 20 cents per trip (10 cents per thousand) extra should be added for additional labor to assist in loading. Taking the above figures as a basis, the cost of hauling different distances is as follows:

TABLE 7.—*Cost of hauling lumber, including loading and unloading.*

Distance of mill from railroad or local market.	Number of trips under average conditions.	Hauling cost per M b. f.		
		Cost of team, $5 minimum.	Cost of team, $6 average.	Cost of team, $7 maximum.
16 miles	1 trip in 2 days	$5.00	$6.00	$7.00
12 miles	2 trips in 3 days	3.75	4.50	5.25
8 miles	1 trip daily	2.50	3.00	3.50
6 miles	3 trips in 2 days	1.67	2.00	2.33
4 miles	2 trips daily	1.33	1.60	1.87
2⅓ miles	3 trips daily	1.00	1.20	1.40
1½ miles	4 trips daily	.87	1.05	1.13
1 mile	5 trips daily	.83	1.00	1.17

TOTAL COST OF LUMBER.

Combining the average costs given in Tables 6 and 7 gives Table 8, which shows the average total cost of producing lumber at different distances from the railroad or local markets.

TABLE 8.—*Cost of producing loblolly pine lumber, per thousand board feet.*

16 miles	$12.00	4 miles	$7.60
12 miles	10.50	2 miles	7.20
8 miles	9.00	1 mile	7.00
6 miles	8.00		

The cost of producing North Carolina pine in southeastern Virginia for the general lumber market by moderate-sized mills varies much less with the distance of the timber from the railroad than in the case of small portable mills. The larger mills are located on a railroad or on water affording facilities for direct transportation to the general market, and use narrow-gauge railroads, locally called trams, for transporting logs from the woods to the mill. These mills have a usual capacity of about 15,000 feet per day, and an actual output of from 2 to 3 million feet a year. Where small portable mills can profitably be set up for a cutting of only 50,000 feet, a moderate-sized mill with tram and dry kiln requires a stand of 2 million or more feet to be logged to the mill at a single point. The cost of producing North Carolina pine in southeastern Virginia by moderate-sized mills where there is a cut of 5 million feet accessible to one set-up is given in Table 9. For larger cuts from one setting of mill and tram the cost of tramming and milling would be less.

TABLE 9.—*Cost of producing North Carolina pine lumber in southeastern Virginia.*

Item.	Tramming distance in miles.						
	1	2	4	6	8	12	16
Cutting and logging to tram, including loading[1]	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00
Tramming[2]	.50	.70	1.10	1.50	1.90	2.70	3.50
Milling, including kiln-drying and loading	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Contractor's profit	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Freight[3]	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total	9.50	9.70	10.10	10.50	10.90	11.70	12.50

[1] Cost of logging within half mile of tram, including cutting, hauling, and loading on cars, is figured at $4 per 1,000, Doyle scale, which amounts to $3 or less mill cut.

[2] $750 per mile (15 cents per 1,000 board feet hauled) is allowed for cost of laying tram and depreciation in value of rails, the latter item being insignificant; and 5 cents per 1,000 board feet allowed for each additional mile of tram for increased cost of maintenance and operation.

[3] Cost of lumbering is figured f. o. b. Norfolk or to the nearest point on the railroad that will have an equally low freight rate to the general market. On an average, for mills in southeastern Virginia, this will add about $1 per 1,000 board feet to the cost of North Carolina pine lumber.

VALUE OF STANDING TIMBER.

The stumpage value or price which a lumber contractor can afford to pay for standing timber represents the difference between the f. o. b. railroad values for lumber and the cost of production. By subtracting from the values given in Table 4 the costs given in Table 8 we obtain the figures given in Table 10, which shows the present stumpage value of standing timber in the Delaware-Maryland-Virginia peninsula at different distances from the railroad.

TABLE 10.—*Value of standing loblolly pine per 1,000 board feet to be cut into boards and in flitch.*

Distance.	1 inch square-edged boards (ungraded).	Flitch.	Distance.	1 inch square-edged boards (ungraded).	Flitch.
16 miles	$1.50		4 miles	$5.90	$2.40
12 miles	3.00		2 miles	6.30	2.80
8 miles	4.50	$1.00	1 mile	6.50	3.00
6 miles	5.50	2.00			

This table represents pretty well the value of standing loblolly pine in most of the area under consideration. Timber of sufficient size to make first-class mine props and within 1 to 2 miles of the railroad in the Delaware-Maryland-Virginia peninsula commands slightly higher stumpage prices for props than is given above for lumber. Many cases can be found, furthermore, of $5 being paid for stumpage as far as 8 miles from the railroad, so that above values may be considered fairly conservative.

The average value, by grades, of standing loblolly pine at different distances from the railroad in the region where the timber is to be sold to the general market as North Carolina pine is shown in Table 11.

This table is based on the values given in Table 5[1] less the cost of production as given in Table 9.

TABLE 11.—*Stumpage value of grades of standing loblolly pine to be cut into North Carolina pine lumber.*

Grade.	Distance from the railroad (miles).						
	1	2	4	6	8	12	16
	Value per 1,000 board feet.						
No. 1	$15.75	$15.55	$15.15	$14.75	$14.35	$13.55	$12.75
No. 2	13.50	13.30	12.90	12.50	12.10	11.30	10.50
No. 3	7.75	7.55	7.15	6.75	6.35	5.55	4.75
No. 4 under 10 inches	5.75	5.55	5.15	4.75	4.35	3.55	2.75
Nos. 1 and 2 bark strips	8.75	8.55	8.15	7.75	7.35	6.55	5.75
Box bark strips	1.00	.80	.40	....	....	....	....

The value of standing loblolly pine timber of different diameters at different distances from the railroad is shown in Tables 12 and 13, the former being for trees cut into inch-thick boards (ungraded) and crate flitch for local consumption, and the latter for trees manufactured into lumber for the general market in accordance with the grading specifications for North Carolina pine lumber. The former includes all trees 5 inches and over in diameter breast-high, while the latter includes only trees 7 inches and over.

TABLE 12.—*Stumpage value of loblolly pine trees of different diameters and of average height to be cut into ungraded square-edged, inch lumber and crate flitch.*[2]

Diameter breasthigh.	Average height.	Distance from the local markets (miles).						
		1	2	4	6	8	12	16
Inches.	*Feet.*							
5	37	$0.02	$0.02	$0.01	$0.01	$0.01	....	....
6	42	.04	.04	.03	.03	.01	....	....
7	47	.16	.15	.14	.13	.11	$0.07	$0.04
8	50	.20	.20	.18	.17	.14	.09	.05
9	54	.26	.25	.24	.22	.18	.12	.06
10	57	.33	.32	.30	.28	.23	.15	.08
11	60	.43	.42	.39	.36	.30	.20	.10
12	62	.57	.55	.52	.48	.40	.26	.13
13	64	.76	.74	.69	.64	.53	.35	.18
14	66	.98	.95	.89	.83	.68	.45	.23
15	68	1.23	1.19	1.12	1.04	.85	.57	.29
16	70	1.46	1.41	1.34	1.23	1.01	.67	.34
17	71	1.65	1.60	1.50	1.40	1.14	.76	.38
18	72	1.84	1.78	1.67	1.56	1.27	.85	.42
19	74	2.01	1.95	1.82	1.70	1.39	.93	.46
20	75	2.18	2.12	1.98	1.85	1.51	1.01	.50

[1] Average prices f. o. b. Norfolk, for the quarter ending June 30, 1912, were used. Prices have risen considerably since June, as shown by Table 5, so values given in Table 11 are conservative.

[2] Based on Table 39, Appendix D, showing amount of flitch and inch lumber cut from trees of different diameters, and Table 10, showing values of these grades on the stump at different distances from the market.

TABLE 13.—*Stumpage value of loblolly pine trees of different diameters, of average height, to be manufactured into North Carolina pine lumber.*[1]

Diameter, breasthigh.	Average height.	Distance from the railroad (miles).						
		1	2	4	6	8	12	16
Inches.	*Feet.*							
7	47	$0.14	$0.14	$0.13	$0.12	$0.11	$0.09	$0.07
8	50	.18	.18	.17	.15	.14	.12	.09
9	54	.26	.25	.23	.22	.20	.17	.14
10	57	.33	.33	.32	.30	.28	.25	.20
11	60	.48	.46	.44	.41	.38	.34	.28
12	62	.63	.62	.60	.56	.51	.45	.38
13	64	.88	.85	.80	.76	.71	.64	.54
14	66	1.17	1.14	1.09	1.02	.95	.84	.73
15	68	1.53	1.49	1.42	1.34	1.27	1.13	.98
16	70	1.87	1.82	1.75	1.66	1.57	1.40	1.22
17	71	2.20	2.14	2.03	1.93	1.83	1.64	1.45
18	72	2.47	2.42	2.30	2.19	2.08	1.87	1.63
19	74	2.76	2.69	2.57	2.45	2.32	2.08	1.83
20	75	3.03	2.96	2.82	2.69	2.55	2.29	2.02

[1] Based on Table 43, Appendix D, showing the amount of grades cut from trees of different diameters, and Table 11, showing value by grades of standing timber at different distances from the market.

The stumpage values per acre of even-aged fully stocked stands of loblolly pine of different ages, on different qualities of soil and at different distances from the railroad, are shown in Tables 14 and 15.

TABLE 14.—*Stumpage value per acre of even-aged, fully stocked stands of loblolly pine cut into ungraded inch boards and crate flitch.*[1]

[All trees 5 inches and over in diameter, breasthigh, included.]

Age (years).	Quality of site.	Distance from railroad (miles).						
		1	2	4	6	8	12	16
		Stumpage value per acre of ungraded boards and flitch.						
20	I	$43.10	$41.44	$38.12	$34.80	$26.50	$15.60	$7.80
	II	26.70	25.62	23.46	21.30	15.90	9.00	4.50
	III	11.55	10.99	9.87	8.75	5.95	2.70	1.35
25	I	70.95	68.53	63.69	58.85	46.75	29.70	14.85
	II	46.00	44.38	41.14	37.90	29.80	18.60	9.30
	III	20.55	19.67	17.91	16.15	11.75	6.30	3.15
30	I	98.80	95.62	89.26	82.90	67.00	43.80	21.90
	II	65.90	63.70	59.30	54.90	43.90	28.20	14.10
	III	30.25	29.05	26.65	24.25	18.25	10.50	5.25
35	I	125.95	122.01	114.13	106.25	86.55	57.30	28.65
	II	84.80	82.04	76.52	71.00	57.20	37.20	18.60
	III	42.35	40.81	37.73	34.65	26.95	16.50	8.25
40	I	154.70	149.94	140.42	130.90	107.10	71.40	35.70
	II	103.70	100.38	93.74	87.10	70.50	46.20	23.10
	III	54.80	52.92	49.16	45.40	36.00	22.80	11.40
45	I	182.65	177.03	165.75	154.55	126.45	84.30	42.15
	II	123.95	120.05	112.25	104.45	84.95	56.10	28.05
	III	69.60	67.34	62.82	58.30	47.00	30.60	15.30
50	I	211.90	205.38	192.34	179.30	146.70	97.80	48.90
	II	146.90	142.38	133.34	124.30	101.70	67.80	33.90
	III	87.10	84.42	79.06	73.70	60.30	40.20	20.10

[1] Based on Table 2, showing yield of fully stocked stands, and Table 10, showing value of loblolly pine at different distances from the railroad.

TABLE 15.—*Stumpage value per acre of even-aged, fully stocked stands of loblolly pine to be manufactured into graded North Carolina pine lumber.*[1]

[Trees 7 inches and over in diameter, breast-high.]

Age (years).	Quality of site.	Distance from railroad miles.						
		1	2	4	6	8	12	16
		Stumpage value per acre of graded North Carolina pine lumber.						
20	I	$32.83	$31.78	$29.69	$27.61	$25.71	$21.93	$18.14
	II	17.81	17.23	16.06	14.89	13.85	11.78	9.71
	III	5.16	4.98	4.60	4.26	3.95	3.32	2.69
30	I	99.50	96.57	90.72	84.87	79.46	68.65	57.84
	II	61.14	59.27	55.52	51.79	48.35	41.49	34.63
	III	22.52	21.81	20.39	18.98	17.68	15.09	12.50
40	I	175.05	170.29	160.77	151.25	142.20	124.13	106.03
	II	108.91	105.82	99.63	93.46	87.67	76.13	64,57
	III	52.66	51.14	48.09	45.05	42.22	36.59	30.95
50	I	259.91	253.38	240.34	227.30	214.66	189.37	164.05
	II	168.49	163.95	154.93	145.28	137.29	120.12	102.94
	III	97.64	94.97	89.62	84.25	79.22	69.14	59 06

[1] Based on Table 23, showing the yield by grades of fully stocked stands, and Table 11, showing value of grades at different distances from the market.

PAST AND FUTURE LUMBER VALUES.

The following tables are given to show the upward tendency in the past of two important grades of North Carolina pine lumber. They indicate that present prices will in all probability be exceeded in the future, or at least be maintained.

Table 16 gives the average wholesale prices at which North Carolina pine rough lumber, under 12 inches in width, was actually sold during 13 quarter-year periods.

TABLE 16.—*North Carolina pine prices per thousand board feet f. o. b. Norfolk.*

Period.	No. 1 edge 4/4[1] under 12-inch width.	Box edge 4/4 under 12-inch width.
October, November, December, 1909	$25.25	$12.50
January, February, March, 1910	22.00	13.00
April, May, June, 1910	24.75	12.50
July, August, September, 1910	24.00	12.50
October, November, December, 1910	24.50	12.50
January, February, March, 1911	24.75	13.00
April, May, June, 1911	24.50	12.50
July, August, September, 1911	24.25	12.75
October, November, December, 1911	24.25	13.50
January, February, March, 1912	25.00	15.25
April, May, June, 1912	25.25	15.25
July, August, September, 1912	25.75	15.75
October, November, December, 1912	27.52	16.99

[1] 4/4 refers to the thickness of the lumber. It means that it is four quarter inches or one inch in thickness.

Table 17 gives the average listed North Carolina Association prices by grades, for rough lumber under 12 inches in width, for the last 24 years. Prices f. o. b. Norfolk, per thousand board feet.

TABLE 17.—*List prices of the North Carolina Pine Association for lumber of different grades, f. o. b. Norfolk, Va.*

Year.	No. 1.	No. 2.	No. 3.	No. 4 or box.	Year.	No. 1.	No. 2.	No. 3.	No. 4 or box.
1899	$15.00	$13.00	$9.50	$7.50	1901	$20.00	$18.00	$13.25	$11.25
1890	15.00	13.00	9.50	7.50	1902	20.00	18.00	13.00	11.50
1891	15.25	13.00	9.50	7.75	1903	20.00	18.00	13.50	12.25
1892	15.75	13.25	9.50	8.25	1904	22.00	18.50	14.50	12.50
1893	15.50	13.50	9.50	8.50	1905	27.50	24.00	19.50	14.75
1894	14.50	13.00	9.50	8.50	1906	30.09	28.00	21.50	16.50
1895	13.75	12.25	9.25	8.25	1907	27.50	25.50	17.50	14.75
1896	13.75	12.00	9.00	7.75	1908	27.00	24.00	17.50	13.50
1897	13.65	11.75	9.00	7.75	1909	27.00	24.00	17.50	13.50
1898	14.60	13.00	10.00	8.25	1910	27.00	24.00	17.50	13.50
1899	18.00	16.25	12.75	11.00	1911	27.00	24.00	17.50	14.00
1900	20.00	18.00	14.00	12.00	1912	33.00	31.00	23.50	[1] 19.50

[1] 1912 figures 20 to 30 per cent higher than average sale prices. Compare with tables 5 and 16. The sudden jump in prices in 1912 was due to a revision of the Association's list prices. These list prices furnish only a slight basis for actual prices, being used to maintain and if possible to raise actual prices.

It will be noted that these list prices run from 50 cents to $1.25 higher on the No. 4 grade than the actual sale prices, and from $2 to $3 higher on the No. 1 grade. They give a good idea, however, of the upward trend of North Carolina pine lumber prices during the last 24 years. Table 18, which gives the average of the above list prices in five-year periods, emphasizes still more strongly the upward tendency of prices, especially for the lower grades.

TABLE 18.—*List prices of the North Carolina Pine Association averaged for 5-year periods, f. o. b. Norfolk per thousand board feet.*

Period.	No. 1.	No. 14 (edge box.)	Period.	No. 1.	No. 4 (edge box.)
1889–1890	$15.00	$7.50	1901–1905	$22.00	$12.50
1891–1895	15.00	8.25	1906–1910	27.70	14.35
1896–1900	16.00	9.25	1911–1912	30.00	16.75

Despite the constant rise in prices the yellow-pine lumber industry has at frequent intervals been seriously handicapped by over production of the lower grades. More recently, however, the tendency of the market has been to call for a large and steady supply of low-grade lumber.

In any event, conditions in regard to low-grade lumber are applicable more to the general lumber market than to lumber produced for local consumption. In the region under consideration, which is rapidly developing along agricultural lines and has immense opportunities for further development, the local lumber trade will become of more and more importance, especially so since the supply of standing timber is becoming more and more limited. In the future, however, wherever it is planned to grow timber for production of lumber for the general market, it will undoubtedly be very important to produce a large percentage of the upper grades.

MANAGEMENT OF LOBLOLLY PINE FORESTS.

ADVISABILITY OF MANAGEMENT.

The profits to be expected from forest management of loblolly pine are shown in Tables 19, 20, 21, 22, 23, and 24, which indicate the possible money returns and corresponding compound interest rates from properly managed stands. Tables 19, 20, and 21 give returns to be expected from fully stocked stands at different ages on Quality I, II, and III soils, where the product is to be manufactured into North Carolina pine rough lumber, cutting all trees 7 inches and over in diameter breast-high, while Tables 22, 23, and 24 give the same where the product is to be cut and sold as ungraded lumber and where all trees 5 inches and over in diameter are cut.

TABLE 19.—*Net profits per acre and corresponding compound interest rates from loblolly pine, for different initial investments, rotations, and distances from market.*

QUALITY I.—FOR TREES 7 INCHES AND OVER IN DIAMETER BREASTHIGH, CUT AND GRADED AS NORTH CAROLINA PINE LUMBER.

Rotation.	Initial investments.			Cost[2] of administration and taxes at 6 per cent compound interest.	Net profit[3] and corresponding compound interest rate[4] on total initial investment at different distances from market or shipping point.							
					1 mile.		4 miles.		8 miles.		16 miles.	
	Land.	Formation.[1]	Total.		Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.
Years.						*Per ct.*		*Per ct.*		*Per ct.*		*Per ct.*
20	$5	$0	$5	$2.21	$30.62	10.31	$27.48	9.81	$23.50	9.09	$15.93	7.42
		3	8		27.62	7.75	24.48	7.26	20.50	6.56	12.93	4.92
		5	10		25.62	6.56	22.48	6.07	18.50	5.38	10.93	3.76
		7	12		23.62	5.59	20.48	5.11	16.50	4.42	8.93	2.82
	10	0	10	3.31	29.52	7.11	26.38	6.67	22.40	6.05	14.83	4.65
		3	13		26.52	5.72	23.38	5.28	19.40	4.67	11.83	3.29
		5	15		24.52	4.96	21.38	4.53	17.40	3.93	9.83	2.55
		7	17		22.52	4.31	19.38	3.88	15.40	3.28	7.83	1.91
30	5	0	5	4.74	94.76	10.49	85.98	10.15	74.72	9.67	53.10	8.52
		3	8		91.76	8.77	82.98	8.44	71.72	7.97	50.10	6.83
		5	10		89.76	7.97	80.98	7.64	69.72	7.17	48.10	6.04
		7	12		87.76	7.31	78.98	6.99	67.72	6.52	46.10	5.40
	10	0	10	7.12	92.38	8.06	83.60	7.74	72.34	7.28	50.72	6.20
		3	13		89.38	7.12	80.60	6.80	69.34	6.35	47.72	5.27
		5	15		87.38	6.61	78.60	6.29	67.34	5.84	45.72	4.77
		7	17		85.38	6.17	76.60	5.85	65.34	5.40	43.72	4.34
40	5	0	5	9.29	165.76	9.23	151.48	8.99	132.91	8.65	96.74	7.82
		3	8		162.76	7.95	148.48	7.72	129.91	7.38	93.74	6.56
		5	10		160.76	7.35	146.48	7.12	127.91	6.78	91.74	5.97
		7	12		158.76	6.86	144.48	6.63	125.91	6.29	89.74	5.49
	10	0	10	13.93	161.12	7.36	146.84	7.12	128.27	6.79	92.10	5.98
		3	13		158.12	6.66	143.84	6.43	125.27	6.09	89.10	5.29
		5	15		156.12	6.28	141.84	6.04	123.27	5.71	87.10	4.91
		7	17		154.12	5.94	139.84	5.71	121.27	5.38	85.10	4.58
50	5	0	5	17.42	242.49	8.12	222.92	7.94	197.24	7.68	146.63	7.06
		3	8		239.49	7.11	219.92	6.93	194.24	6.67	143.63	6.06
		5	10		237.49	6.63	217.92	6.45	192.24	6.20	141.63	5.59
		7	12		235.49	6.24	215.92	6.06	190.24	5.81	139.63	5.20
	10	0	10	26.13	233.78	6.60	214.21	6.42	188.53	6.16	137.92	5.54
		3	13		230.78	6.04	211.21	5.86	185.53	5.60	134.92	4.98
		5	15		228.78	5.74	209.21	5.56	183.53	5.30	132.92	4.68
		7	17		226.78	5.47	207.21	5.29	181.53	5.04	130.92	4.42

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[1] Cost of establishing a loblolly pine stand, either by natural or artificial reproduction.

[2] Three cents per acre annually for administration (including fire protection), and 6 mills on the dollar (full valuation) annually for taxes, which is above present average tax for the region.

[3] Stumpage value as given in Table 15, less original cost of formation and total cost of administration and taxes. Where no net profit is shown, a loss is indicated.

[4] Calculated by formula $p=100\left(\sqrt[n]{\frac{S+L-A}{L+F}}-1\right)$, where p=compound interest rate, n=number of years or rotation, S=stumpage value at n years, L=cost of land, F=cost of formation, and A=cost of administration and taxes in n years at 6 per cent compound interest.

TABLE 20.—*Net profits per acre and corresponding compound interest rates from loblolly pine, for different initial investments, rotations, and distances from market.*

QUALITY II.—FOR TREES 7 INCHES AND OVER IN DIAMETER BREASTHIGH, CUT AND GRADED AS NORTH CAROLINA PINE LUMBER.

Rotation.	Initial investments.			Cost[2] of administration and taxes at 6 per cent compound interest.	Net profit[3] and corresponding compound interest rate[4] on total initial investment at different distances from market or shipping point.							
	Land.	Formation.[1]	Total.		1 mile.		4 miles.		8 miles.		16 miles.	
					Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.
Years.						Per ct.		Per ct.		Per ct.		Per ct.
20	$5	$0	$5	$2.21	$15.60	7.34	$13.85	6.86	$11.64	6.20	$7.50	4.68
		3	8		12.60	4.84	10.85	4.38	8.64	3.73	4.50	2.26
		5	10		10.60	3.68	8.85	3.22	6.64	2.58	2.50	1.12
		7	12		8.60	2.74	6.85	2.28	4.64	1.65	.50	.21
	10	0	10	3.31	14.50	4.58	12.75	4.20	10.54	3.66	6.40	2.51
		3	13		11.50	3.22	9.75	2.84	7.54	2.31	3.40	1.17
		5	15		9.50	2.48	7.75	2.10	5.54	1.58	1.40	.45
		7	17		7.50	1.84	5.75	1.47	3.54	.95	....	....
30	5	0	5	4.74	56.40	8.72	50.78	8.37	43.61	7.88	29.89	6.69
		3	8		53.40	7.03	47.78	6.69	40.61	6.20	26.89	5.03
		5	10		51.40	6.24	45.78	5.90	38.61	5.41	24.89	4.25
		7	12		49.40	5.59	43.78	5.25	36.61	4.77	22.89	3.62
	10	0	10	7.12	54.02	6.38	48.40	6.06	41.23	5.60	27.51	4.50
		3	13		51.02	5.46	45.40	5.14	38.23	4.68	24.51	3.59
		5	15		49.02	4.96	43.40	4.63	36.23	4.18	22.51	3.10
		7	17		47.02	4.52	41.40	4.20	34.23	3.75	20.51	2.67
40	5	0	5	9.29	99.62	7.90	90.34	7.65	78.38	7.29	55.28	6.42
		3	8		96.62	6.64	87.34	6.39	75.38	6.03	52.28	5.18
		5	10		94.62	6.04	85.34	5.80	73.38	5.45	50.28	4.59
		7	12		92.62	5.56	83.34	5.32	71.38	4.96	48.28	4.19
	10	0	10	13.93	94.98	6.05	85.70	5.81	73.74	5.46	50.64	4.61
		3	13		91.98	5.36	82.70	5.12	70.74	4.77	47.64	3.92
		5	15		89.98	4.98	80.70	4.74	68.74	4.39	45.64	3.55
		7	17		87.98	4.66	78.70	4.41	66.74	4.07	43.64	3.23
50	5	0	5	17.42	151.07	7.13	137.51	6.93	119.87	6.65	85.52	5.96
		3	8		148.07	6.12	134.51	5.93	116.87	5.65	82.52	4.97
		5	10		146.07	5.65	132.51	5.46	114.87	5.18	80.52	4.50
		7	12		144.07	5.26	130.51	5.07	112.87	4.80	78.52	4.12
	10	0	10	26.13	142.36	5.60	128.80	5.40	111.16	5.12	76.81	4.42
		3	13		139.36	5.05	125.80	4.85	108.16	4.56	73.81	3.87
		5	15		137.36	4.75	123.80	4.55	106.16	4.27	71.81	3.57
		7	17		135.36	4.48	121.80	4.29	104.16	4.01	69.81	3.31

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[1] Cost of establishing a loblolly pine stand, either by natural or artificial reproduction.

[2] Three cents per acre annually for administration (including fire protection), and 6 mills on the dollar (full valuation) annually for taxes, which is above present average tax for the region.

[3] Stumpage value as given in Table 15, less original cost of formation and total cost of administration and taxes. Where no net profit is shown, a loss is indicated.

[4] Calculated by formula $p=100\left(\sqrt[n]{\frac{S+L-A}{L+F}}-1\right)$, where p=compound interest rate, n=number of years or rotation, S=stumpage value at n years, L=cost of land, F=cost of formation, and A=cost of administration and taxes in n years at 6 per cent compound interest.

Table 21.—*Net profits per acre and corresponding compound interest rates from loblolly pine, for different initial investments, rotations, and distances from market.*

Quality III.—FOR TREES 7 INCHES AND OVER IN DIAMETER BREAST HIGH, CUT AND GRADED AS NORTH CAROLINA PINE LUMBER.

Rotation.	Initial investment.			Cost[2] of administration and taxes at 6 per cent compound interest.	Net profit[3] and corresponding compound interest rate[4] on total initial investment at different distances from market or shipping point.							
	Land.	Formation.[1]	Total.		1 mile.		4 miles.		8 miles.		16 miles.	
					Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.
Years.						*Per ct.*		*Per ct.*		*Per ct.*		*Per ct.*
20	$5	$0	$5	$2.21	$2.95	2.35	$2.39	1.97	$1.74	1.50	$0.48	0.46
		3	8		-------	-------	-------	-------	-------	-------	-------	-------
		5	10		-------	-------	-------	-------	-------	-------	-------	-------
		7	12		-------	-------	-------	-------	-------	-------	-------	-------
	10	0	10	3.31	1.85	.85	1.29	.61	.64	.31	-------	-------
		3	13		-------	-------	-------	-------	-------	-------	-------	-------
		5	15		-------	-------	-------	-------	-------	-------	-------	-------
		7	17		-------	-------	-------	-------	-------	-------	-------	-------
30	5	0	5	4.74	17.78	5.18	15.65	4.84	12.94	4.35	7.76	3.17
		3	8		14.78	3.56	12.65	3.21	9.94	2.73	4.76	1.57
		5	10		12.78	2.78	10.65	2.45	7.94	1.97	2.76	.82
		7	12		10.78	2.16	8.65	1.83	5.94	1.35	.76	.20
	10	0	10	7.12	15.40	3.16	13.27	2.86	10.56	2.43	5.38	1.44
		3	13		12.40	2.26	10.27	1.96	7.56	1.54	2.38	.56
		5	15		10.40	1.77	8.27	1.47	5.56	1.06	.38	.08
		7	17		8.40	1.35	6.27	1.05	3.56	.63	-------	-------
40	5	0	5	9.29	43.37	5.84	38.80	5.58	32.93	5.20	21.66	4.27
		3	8		40.37	4.60	35.80	4.34	29.93	3.97	18.66	3.06
		5	10		38.37	4.02	33.80	3.76	27.93	3.39	16.66	2.48
		7	12		36.37	3.55	31.80	3.29	25.93	2.92	14.66	2.02
	10	0	10	13.93	38.73	4.04	34.16	3.78	28.29	3.41	17.02	2.52
		3	13		35.73	3.36	31.16	3.10	25.29	2.74	14.02	1.85
		5	15		33.73	2.99	29.16	2.74	23.29	2.37	12.02	1.48
		7	17		31.73	2.67	27.16	2.42	21.29	2.05	10.02	1.16
50	5	0	5	17.42	80.22	5.83	72.20	5.63	61.80	5.32	41.64	4.57
		3	8		77.22	4.84	69.20	4.64	58.80	4.34	38.64	3.59
		5	10		75.22	4.38	67.20	4.17	56.80	3.87	36.64	3.13
		7	12		73.22	4.00	65.20	3.79	54.80	3.49	34.64	2.75
	10	0	10	26.13	71.51	4.29	63.49	4.07	53.09	3.75	32.93	2.96
		3	13		68.51	3.74	60.49	3.53	50.09	3.21	29.93	2.42
		5	15		66.51	3.44	58.49	3.23	48.09	2.91	27.93	2.12
		7	17		64.51	3.18	56.49	2.97	46.09	2.66	25.93	1.87

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[1] Cost of establishing a loblolly pine stand, either by natural or artificial reproduction.

[2] Three cents per acre annually for administration (including fire protection), and 6 mills on the dollar (full valuation) annually for taxes, which is above present average tax for the region.

[3] Stumpage value as given in Table 15, less original cost of formation and total cost of administration and taxes. Where no net profit is shown, a loss is indicated.

[4] Calculated by formula $p=100\left(\sqrt[n]{\frac{S+L-A}{L+F}}-1\right)$, where p=compound interest rate, n=number of years or rotation, S=stumpage value at n years, L=cost of land, F=cost of formation, and A=cost of administration and taxes in n years at 6 per cent compound interest.

TABLE 22.—*Net profits per acre and corresponding compound interest rates from loblolly pine, for different initial investments, rotations, and distances from market.*

QUALITY I.—FOR TREES 5 INCHES AND OVER IN DIAMETER BREASTHIGH, LUMBER CUT AND SOLD UNGRADED.

Rotation.	Initial investment.			Cost[2] of administration and taxes at 6 per cent compound interest.	Net profit[3] and corresponding compound interest rate[4] on total initial investment at different distances from market or shipping point.							
					1 mile.		4 miles.		8 miles.		16 miles.	
	Land.	Formation.[1]	Total.		Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.
Years.						*Per ct.*		*Per ct.*		*Per ct.*		*Per ct.*
20	$5	$0	$5	$2.21	$40.89	11.72	$35.91	11.08	$24.29	9.24	$5.59	3.82
		3	8		37.89	9.13	32.91	8.50	21.29	6.70	2.59	1.41
		5	10		35.89	7.92	30.91	7.30	19.29	5.52	.59	.29
		7	12		33.89	6.94	28.91	6.32	17.29	4.56	......	......
	10	0	10	3.31	39.79	8.36	34.81	7.79	23.19	6.18	4.49	1.87
		3	13		36.79	6.94	31.81	6.38	20.19	4.80	1.49	.54
		5	15		34.79	6.18	29.81	5.62	18.19	4.05	....	....
		7	17		32.79	5.52	27.81	4.97	16.19	3.40	....	....
30	5	0	5	4.74	94.06	10.47	84.52	10.09	62.26	9.05	17.16	5.09
		3	8		91.06	8.74	81.52	8.38	59.26	7.36	14.16	3.45
		5	10		89.06	7.94	79.52	7.58	57.26	6.56	12.16	2.69
		7	12		87.06	7.29	77.52	6.93	55.26	5.91	10.16	2.07
	10	0	10	7.12	91.68	8.04	82.14	7.68	59.88	6.70	14.78	3.07
		3	13		88.68	7.10	79.14	6.75	56.88	5.77	11.78	2.17
		5	15		86.68	6.59	77.14	6.24	54.88	5.26	9.78	1.69
		7	17		84.68	6.14	75.14	5.79	52.88	4.83	7.78	1.26
40	5	0	5	9.29	145.41	8.88	131.13	8.61	97.81	7.85	26.41	4.70
		3	8		142.41	7.61	128.13	7.34	94.81	6.59	23.41	3.48
		5	10		140.41	7.01	126.13	6.75	92.81	6.00	21.41	2.90
		7	12		138.41	6.52	124.13	6.26	90.81	5.52	19.41	2.44
	10	0	10	13.93	140.77	7.02	126.49	6.75	93.17	6.01	21.77	2.93
		3	13		137.77	6.32	123.49	6.05	90.17	5.31	18.77	2.26
		5	15		135.77	5.94	121.49	5.68	88.17	4.94	16.77	1.89
		7	17		133.77	5.61	119.49	5.35	86.17	4.61	14.77	1.58
50	5	0	5	17.42	194.48	7.65	174.92	7.42	129.28	6.80	31.48	4.06
		3	8		191.48	6.64	171.92	6.42	126.28	5.80	28.48	3.08
		5	10		189.48	6.17	169.92	5.95	124.28	5.33	26.48	2.62
		7	12		187.48	5.78	167.92	5.56	122.28	4.95	24.48	2.25
	10	0	10	26.13	185.77	6.13	166.21	5.91	120.57	5.27	22.77	2.40
		3	13		182.77	5.57	163.21	5.35	117.57	4.72	19.77	1.87
		5	15		180.77	5.27	161.21	5.05	115.57	4.42	17.77	1.57
		7	17		178.77	5.01	159.21	4.79	113.57	4.16	15.77	1.32

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[1] Cost of establishing a loblolly pine stand, either by natural or artificial reproduction.

[2] Three cents per acre annually for administration (including fire protection) and 6 mills on the dollar (full valuation) annually for taxes, which is above present average tax for the region.

[3] Stumpage value as given in Table 14, less original cost of formation and total cost of administration and taxes. Where no net profit is shown, a loss is indicated.

[4] Calculated by formula $p=100\left(\sqrt[n]{\frac{S+L-A}{L+F}}-1\right)$, where p = compound interest rate, n=number of years or rotation, S=stumpage value at n years, L=cost of land, F=cost of formation, and A=cost of administration and taxes in n years at 6 per cent compound interest.

TABLE 23.—*Net profits per acre and corresponding compound interest rates from loblolly pine, for different initial investments, rotations, and distances from market.*

QUALITY II.—FOR TREES 5 INCHES AND OVER IN DIAMETER BREASTHIGH, LUMBER CUT AND SOLD UNGRADED.

Rotation.	Initial investment.			Cost[2] of administration and taxes at 6 per cent compound interest.	Net profit[3] and corresponding compound interest rate[4] on total initial investment at different distances from market or shipping point.							
					1 mile.		4 miles.		8 miles.		16 miles.	
	Land.	Formation.[1]	Total.		Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.
Years.						*Per ct.*		*Per ct.*		*Per ct.*		*Per ct.*
20	$5	$0	$5	$2.21	$24.49	9.28	$21.25	8.64	$13.69	6.82	$2.29	1.90
		3	8		21.49	6.74	18.25	6.12	10.69	4.33	......	......
		5	10		19.49	5.56	16.25	4.94	8.69	3.18	......	......
		7	12		17.49	4.60	14.25	3.99	6.69	2.24	......	......
	10	0	10	3.31	23.39	6.21	20.15	5.67	12.59	4.16	1.19	.56
		3	13		20.39	4.83	17.15	4.30	9.59	2.80	......	......
		5	15		18.39	4.08	15.15	3.55	7.59	2.07	......	......
		7	17		16.39	3.43	13.15	2.91	5.59	1.43	......	......
30	5	0	5	4.74	61.16	8.99	54.56	8.61	39.16	7.53	9.36	3.58
		3	8		58.16	7.30	51.56	6.92	36.16	5.86	6.36	1.97
		5	10		56.16	6.50	49.56	6.13	34.16	5.08	4.36	1.21
		7	12		54.16	5.85	47.56	5.49	32.16	4.44	2.36	.60
	10	0	10	7.12	58.78	6.64	52.18	6.28	36.78	5.28	6.98	1.78
		3	13		55.78	5.71	49.18	5.36	33.78	4.36	3.98	.89
		5	15		53.78	5.21	47.18	4.85	31.78	3.86	1.98	.41
		7	17		51.78	4.77	45.18	4.42	29.78	3.43	......	......
40	5	0	5	9.29	94.41	7.76	84.45	7.48	61.21	6.67	13.81	3.37
		3	8		91.41	6.50	81.45	6.22	58.21	5.43	10.81	2.16
		5	10		89.41	5.91	79.45	5.63	56.21	4.84	8.81	1.59
		7	12		87.41	5.43	77.45	5.15	54.21	4.36	6.81	1.13
	10	0	10	13.93	89.77	5.92	79.81	5.64	56.57	4.85	9.17	1.64
		3	13		86.77	5.23	76.81	4.95	53.57	4.17	6.17	.98
		5	15		84.77	4.85	74.81	4.58	51.57	3.80	4.17	.61
		7	17		82.77	4.52	72 81	4.25	49.57	3.47	2.17	.30
50	5	0	5	17.42	129.48	6.81	115.92	6.58	84.28	5.93	16.48	2.96
		3	8		126.48	5.81	112.92	5.58	81.28	4.94	13.48	2.00
		5	10		124.48	5.34	110.92	5.11	79.28	4.48	11.48	1.54
		7	12		122.48	4.95	108.92	4.73	77.28	4.10	9.48	1.17
	10	0	10	26.13	120.77	5.28	107.21	5.05	75.57	4.39	7.77	1.17
		3	13		117.77	4.72	104.21	4.50	72.57	4.08	4.77	.63
		5	15		115.77	4.43	102.21	4.20	70.57	3.54	2.77	.34
		7	17		113.77	4.16	100.21	3.94	68.57	3.29	.77	.09

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[1] Cost of establishing a loblolly pine stand, either by natural or artificial reproduction.

[2] Three cents per acre annually for administration (including fire protection), and 6 mills on the dollar (full valuation) annually for taxes, which is above present average tax for the region.

[3] Stumpage value as given in Table 14, less original cost of formation and total cost of administration and taxes. Where no net profit is shown, a loss is indicated.

[4] Calculated by formula $p=100\left(\sqrt[n]{\frac{S+L-A}{L+F}}-1\right)$, where p= compound interest rate, n=number of years or rotation, S=stumpage value at n years, L=cost of land, F=cost of formation, and A=cost of administration and taxes in n years at 6 per cent compound interest.

TABLE 24.—*Net profits per acre and corresponding compound interest rates from loblolly pine, for different initial investments, rotations, and distances from market.*

QUALITY III.—FOR TREES 5 INCHES AND OVER IN DIAMETER BREASTHIGH, LUMBER CUT AND SOLD UNGRADED.

Rotation.	Initial investment.			Cost [2] of administration and taxes at 6 per cent compound interest.	Net profit [3] and corresponding compound interest rate [4] on total initial investment at different distances from market or shipping point.							
	Land.	Formation.[1]	Total.		1 mile.		4 miles.		8 miles.		16 miles.	
					Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.	Net profit.	Interest rate.
Years.						*Per ct.*		*Per ct.*		*Per ct.*		*Per ct.*
20	$5	$0	$5	$2.21	$9.34	5.41	$7.66	4.75	$3.74	2.83	......	......
		3	8		6.34	2.96	4.66	2.32	.74	.45	......	......
		5	10		4.34	1.82	2.66	1.19	......	......	......	......
		7	12		2.34	.90	.66	.27	......	......	......	......
	10	0	10	3.31	8.24	3.05	6.56	2.55	2.64	1.18	......	......
		3	13		5.24	1.71	3.56	1.22	......	......	......	......
		5	15		3.24	.98	1.56	.50	......	......	......	......
		7	17		1.24	.35	......	......	......	......	......	......
30	5	0	5	4.74	25.51	6.22	21.91	5.77	13.51	4.46	$0.51	0.32
		3	8		22.51	4.56	18.91	4.13	10.51	2.84	......	......
		5	10		20.51	3.79	16.91	3.35	8.51	2.07	......	......
		7	12		18.51	3.16	14.91	2.73	6.51	1.46	......	......
	10	0	10	7.12	23.13	4.07	19.53	3.68	11.13	2.53	......	......
		3	13		20.13	3.17	16.53	2.77	8.13	1.63	......	......
		5	15		18.13	2.68	14.53	2.28	6.13	1.15	......	......
		7	17		16.13	2.25	12.53	1.86	4.13	.73	......	......
40	5	0	5	9.29	45.51	5.95	39.87	5.64	26.71	4.73	2.11	.88
		3	8		42.51	4.71	36.87	4.41	23.71	3.50	......	......
		5	10		40.51	4.13	34.87	3.82	21.71	2.93	......	......
		7	12		38.51	3.66	32.87	3.35	19.71	2.46	......	......
	10	0	10	13.93	40.87	4.15	35.23	3.84	22.07	2.96	......	......
		3	13		37.87	3.47	32.23	3.17	19.07	2.28	......	......
		5	15		35.87	3.10	30.23	2.80	17.07	1.92	......	......
		7	17		33.87	2.78	28.23	2.48	15.07	1.60	......	......
50	5	0	5	17.42	69.68	5.56	61.64	5.32	42.88	4.62	2.68	.86
		3	8		66.68	4.57	58.64	4.33	39.88	3.64	......	......
		5	10		64.68	4.10	56.64	3.87	37.88	3.18	......	......
		7	12		62.68	3.72	54.64	3.49	35.88	2.81	......	......
	10	0	10	26.13	60.97	4.00	52.93	3.75	34.17	3.02	......	......
		3	13		57.97	3.45	49.93	3.20	31.17	2.48	......	......
		5	15		55.97	3.16	47.93	2.91	29.17	2.18	......	......
		7	17		53.97	2.90	45.93	2.65	27.17	1.93	......	......

[1] Cost of establishing a loblolly pine stand, either by natural or artificial reproduction.

[2] Three cents per acre annually for administration (including fire protection), and 6 mills on the dollar (full valuation) annually for taxes, which is above present average tax for the region.

[3] Stumpage value as given in Table 14, less original cost of formation and total cost of administration and taxes. Where no net profit is shown, a loss is indicated.

[4] Calculated by formula $p=100\left(\sqrt[n]{\frac{S+L-A}{L+F}}-1\right)$, where p= compound interest rate, n=number of years or rotation, S=stumpage value at n years, L=cost of land, F=cost of formation, and A=cost of administration and taxes in n years at 6 per cent compound interest.

The preceding tables indicate under what conditions of quality of soil, cost of land, cost of establishing crop, and distance from market forest management of loblolly pine will be profitable or advisable as a business proposition. For instance, Table 22 indicates that on 1 acre of Quality I soil, 1 mile from the railroad, where there is no cost for establishing a crop of loblolly pine, it will be possible to realize 10.47 per cent compound interest in 30 years on an initial investment of $5 for the land. If the land costs $10 there would be 8.04 per cent compound interest realized on the initial investment. These represent the most favorable conditions. Under similar conditions on Quality III land (see Table 24), on the other hand, in 30 years there will be a compound interest of only 6.22 per cent on $5 land and of 4.07 per cent on $10 land; while at 8 miles from the railroad under similar conditions the compound interest rate possible to realize would be 4.46 and 2.53 per cent, respectively, on $5 and $10 land.

Loblolly pine occurs almost entirely on land that is potentially agricultural. This includes large areas of poorly drained land which at considerable expense can be converted into good agricultural sites, and land formerly under cultivation but worn out and abandoned. For several generations it will probably pay best to continue to grow crops of timber, at comparatively little expense, on large areas of this land, and to practice intensive agriculture, requiring large outlays of money, on limited areas best adapted to crops. A properly managed woodlot will always be a necessity to the well-equipped farm, even if the only land available for this purpose is potentially agricultural.

In the management of forest types in which loblolly pine occurs it is generally advisable to favor it in the reproduction of a new stand to the exclusion of most of the species associated with it. It is preferable to other pines (shortleaf, pitch, and scrub) because its growth is more rapid, it produces cleaner timber and more seed, and on moist to wet soils, or on light dry soils with an open seed bed, it reproduces better. It is preferable to reproduce to pine rather than to hardwoods, with the exception of yellow poplar, because pine will reach maturity and command a good stumpage price at an earlier age, especially on the poorer soils. On heavy and dry upland soils, where loblolly is comparatively scarce, it is best to favor shortleaf pine, as it is better adapted than loblolly to such sites. By using the method for securing loblolly pine reproduction described in this bulletin it will be possible to secure pure stands of the species, or at least make it the preponderating species in a future stand. A limited admixture of other species of pine and hardwoods of the same age will never handicap the rapid-growing loblolly, and it will not usually be advisable to go to any considerable expense in order to exclude them entirely.

NORMAL STANDS AND ROTATION.

In forest management of loblolly pine the aim should be to secure (preferably by natural reproduction, which is less expensive) pure, fully-stocked (uniformly dense), and even-aged stands of the species. These are technically known as normal stands, and produce the largest yield of timber per acre on a short rotation, and give the best chance of development to the trees composing them. Cuttings can best be regulated in such stands, both reproduction cuttings in mature and improvement thinnings in immature stands. Moreover, conditions for the germination of seed and the growth of seedlings are much better following the cutting of a densely stocked than of an openly stocked stand. Only a small percentage of unmanaged loblolly stands are fully stocked, or normal. It will usually be possible, however, by leaving several good loblolly seed trees per acre, evenly distributed, to secure sufficient natural reproduction on a cut-over area to form a fully stocked stand of second growth. On areas with an insufficient number of loblolly seed trees, or with seed trees unevenly distributed, sowing or planting to supplement natural reproduction will be necessary if it is wished to get a normal stand.

One of the first steps in forest management is to decide the rotation, or age at which the forest is to be considered mature, and at which to cut and reproduce it. On a rotation of from 20 to 30 years for loblolly pine it is only possible to produce round-edge box boards, crating stuff, and lumber of the lowest grades and of small value. On a rotation of from 35 to 45 years considerable medium-grade lumber can be produced which will command a fair stumpage price. But to produce any very considerable percentage of lumber of the best grades a rotation of from 50 to 100 years is necessary. The rotation to obtain the highest rate of interest on the original investment in a loblolly-pine forest appears from Tables 19, 20, 21, 22, 23, and 24 to be, for the most part, from 30 to 50 years—longer on Quality III and shorter on Quality I soils. Although these tables go only to 50 years, it is safe to say that a longer rotation, even after allowing for increase in the board feet yield and stumpage value would not show such a high rate of interest on the money invested There is also to be considered the danger from fire, insects, and disease, which is against a long rotation. A rotation of from 35 to 45 years is also the best silviculturally, because at this age loblolly-pine stands can be most easily reproduced. This is especially true where loblolly occurs as a temporary forest type, which, if left to the course of nature, would gradually revert to the original type.

The time for cutting any particular stand, however, should not necessarily be made to coincide with the rotation which has been previously decided upon as the best, but should also be influenced by the condition of the lumber market and the occurrence of seed years. In some cases the market may make it advisable to let the stand grow for a much longer period than the rotation calls for, in order to produce more lumber of the higher grades, or a combination of a good seed year and a good market for low-grade stuff may warrant cutting on a shorter rotation.

FIRE PROTECTION.

Management of loblolly-pine land to secure successive crops of timber is not advisable unless there is a reasonable certainty that forest fires can and will be controlled or kept out entirely. Adequate protection from fire, therefore, must be provided before it becomes worth while to incur any expense connected with forest management. Fire kills the reproduction, thins out existing stands, and lessens the rate of growth of the remaining trees by impairing their vitality and by reducing the productive capacity of the soil. The thinning is done by (1) killing trees outright; (2) weakening trees so that they succumb to attacks of insects or fungi; (3) burning the trunks so that the trees are broken off or thrown by the wind.

In loblolly pine it is best to keep fire out entirely. The only exception to this rule is in burning brush litter and undergrowth after lumbering to lessen the possibility of future damage from fire and to improve conditions for reproduction. Such burnings, however, should not be carried out unless it is certain that the fire can and will be limited to the area it is wished to stock.

It is a comparatively simple and easy matter to keep fire out of small blocks of timber, up to 500 acres in extent, when these are adjacent to farms or bounded by roads, cultivated fields, streams, and other barriers. The owner should be careful, however, not to allow his woods to catch from his own brush fires. He should also post his land with trespass and fire notices, keep a watch for fires continually during dry periods, and extinguish as soon as possible any which may start. The larger the area the more difficult it is to keep fire out.

For large areas the principal means of fire protection include: (1) Piling and burning of slash left after lumbering, which will also often assist reproduction; (2) development of roads, trails, and fire lines; (3) organization of a patrol and fire-fighting force, with proper equipment for fighting fires; (4) use of spark arresters on locomotives and donkey engines used in logging; (5) posting of timber-trespass and fire-warning notices and vigorous application of State fire laws, where possible, against setting of forest fires; (6) cooperative fire-protective agreements or understandings with adjacent landowners.

For detailed discussion of means and methods to employ where it is aimed to exclude all fire from the forest, and methods of fighting fire, the reader is referred to Bulletin 82 of the Forest Service, "Protection of Forests from Fire," by Henry S. Graves, Forester.

REFORESTATION BY NATURAL REPRODUCTION.

To secure natural reproduction of loblolly pine it is necessary to cut the mature stand in such a way that seed will be disseminated evenly over the bed. The subject will be discussed under the general headings of (1) methods of cutting and (2) work following cutting.

Methods of Cutting.

There are three general methods of cutting loblolly-pine forests to provide for the proper seeding of the area cut: (1) Clean cutting except for scattered individuals or groups of loblolly-pine seed trees; (2) clean cutting in strips or patches; (3) successive thinning method. The two last methods are adapted chiefly to pure or nearly pure stands of loblolly, while the first is suitable to all types and mixtures in which the species occurs.

SCATTERED SEED TREES AND SCATTERED GROUPS.

The scattered seed-tree method consists in clean cutting everything except from 4 to 10 loblolly pine seed trees per acre, left evenly distributed over the area to be reproduced. This is the simplest method and the one usually to be recommended, as it is adaptable to both pure stands and to loblolly in mixture with other species. The cutting should preferably be made when it is seen that there will be a good seed year. The number of seed trees which should be left varies with their height; if over 70 feet tall, from 4 to 7 trees per acre will be sufficient; if under 70 feet tall a larger number will be necessary. Tress which will produce the most seed should be left, i. e., trees with the largest crowns, which are also the most windfirm. Whenever there is much danger from windfall it will be best to leave scattered groups of from 3 to 9 trees. Seed trees or groups should be left to grow for another rotation, or taken out when an improvement thinning is made in the new stand. In case of mixed stands it is important to cut clean all trees of other species and to leave only loblolly seed trees.

CLEAN CUTTING IN STRIPS AND PATCHES.

These methods consist in clean cutting in strips from 100 to 150 feet wide, or clean cutting patches from 100 to 300 feet across, to be seeded from the adjacent or surrounding forest which remains intact until the area is reproduced. This method is best adapted to pure or nearly pure stands, and in any case a large proportion of the dominant trees along the edge of the adjacent uncut stand should be loblolly pine. Especial care should be taken to leave the forest intact on the side from which the prevailing fall and winter winds blow, in order to insure dissemination of the seed over the area cut. The cutting should preferably be made when it is seen that there will be a good seed year. The width of the strips should not exceed twice the height of the trees in the adjacent uncut forest, while the width of clean-cut patches can be somewhat greater.

Not over two-thirds of the area of the forest should be contained in the strips or patches cut, and preferably not more than half; in the latter case the intact areas between the strips or patches would be equal in size to the strips or patches which are clean cut.

These methods of cutting can sometimes be advantageously used in conjunction with the scattered seed-tree method. When it is wished to cut in wider strips or larger patches than can be adequately seeded from the adjacent woods, reproduction on remote parts can be provided for by leaving scattered seed trees or groups of trees.

SUCCESSIVE THINNINGS.

This consists in removing the mature stand in two or three cuttings. It is adapted primarily to fully stocked stands of practically pure loblolly pine. Under this method the reproduction takes place more or less under the shelter of the old trees left. It can best be used on moist or wet situations, where loblolly-pine seedlings are comparatively tolerant of shade. The first cutting, so called, which may often be omitted, consists in a heavy thinning to give the crowns and roots of the trees left more growing space, thus causing them to produce more seed. Overtopped and small-crowned loblolly trees should be removed in this cutting, but the thinning should not be so heavy as to seriously interrupt the crown cover and cause large openings in the leaf canopy, which would result in the luxuriant growth of weeds and underbrush. Trees of other species, if any occur, should all be removed at this cutting. The second cutting should be made when it is seen that there is a good seed year at hand. The largest crowned trees should be left, since these produce the most seed. At this cutting about one-half the volume of the stand should be removed. The third cutting should preferably be made as soon as possible after adequate reproduction has taken place, which should be accomplished within 1 to 5 years. The younger and smaller the seedlings the less will be the damage done to them in removing the old trees. Where it is wished to take advantage of the increased growth of trees left after cutting, or where the market conditions warrant, the periods between the first and second and the second and third cuts might be prolonged to [illegible] or 10 years, though this will usually be disadvantageous to the reproduction.

ORDINARY METHODS OF CUTTING.

The necessity of properly planned systematic cutting according to one of the methods just described can not too strongly be emphasized whenever it is wished to provide for adequate seed production. Under ordinary methods of lumbering it is purely a matter of chance whether there will be a sufficient number of properly distributed seed trees left after cutting. Of the ordinary methods the most favorable to reproduction is the diameter-limit method, but even this is a makeshift in providing for a future stand, and only under exceptional conditions can it be relied upon to furnish adequate seed production.

Under this method the stand is cut to a rough diameter limit, either because it does not actually pay to cut trees below that limit or because it is wished to leave trees to form the basis for a second cut 10 to 20 years later.

If, in pure well-stocked stands, a large number of trees remain after lumbering by the diameter-limit method, excellent results will often be had both in the growth of trees left and in the seeding of a new stand, the cutting, in its effects, amounting to a modified form of the method of successive thinnings. The chief drawback is that the small-crowned overtopped trees, such as would be left under this method, require a number of years to recover from suppression before producing much seed; and, furthermore, a large proportion of them usually die or are windthrown or broken within a few years after lumbering, especially on dry and exposed situations. It sometimes happens, however, as shown in Table 25, that the area cut under this method is immediately seeded up from seed produced by the large-crowned trees removed at the cutting, or from seed trees left in the vicinity of the area cut. Table 25 is a summary of the results of cutting a half-acre plot in a 35-year-old fully stocked stand of loblolly pine on fresh, sandy soil, to a diameter limit of 12 inches breasthigh in the winter of 1904. The stand was measured in 1906, and remeasured 4½ years later. It indicates what sometimes happens, under favorable conditions, in cutting by the ordinary diameter-limit method. (See Plate III.)

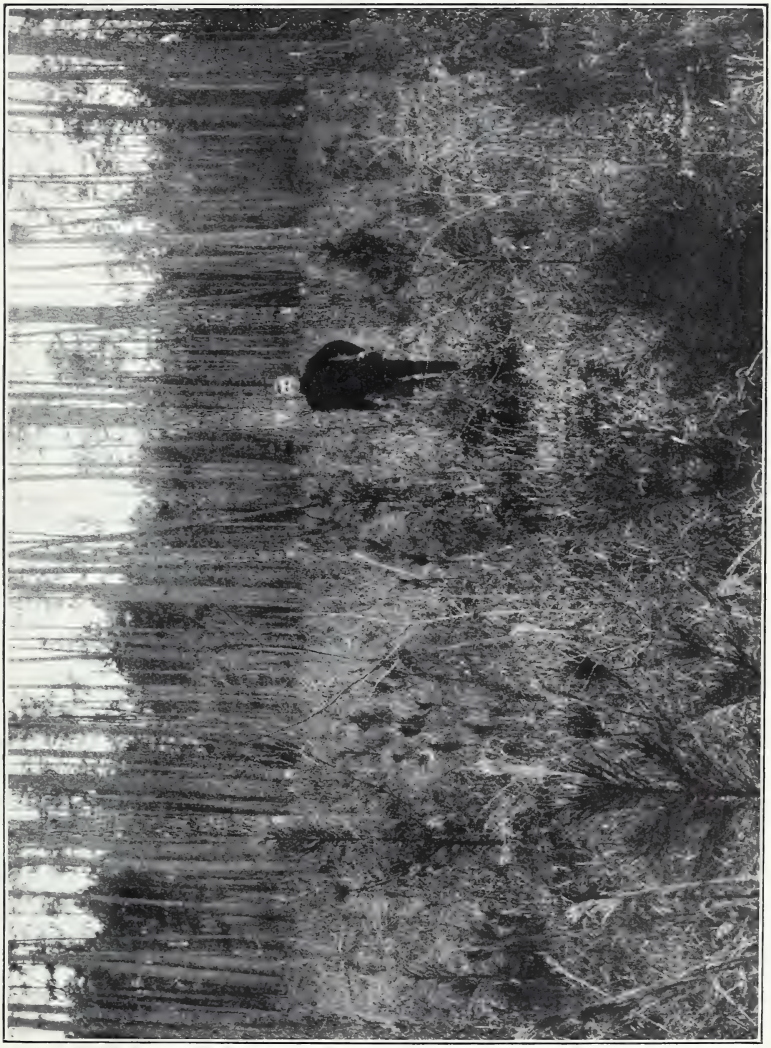
TABLE 25.—*Effect of a diameter-limit cutting on a half acre of even-aged, fully stocked loblolly pine 35 years old.*

TREES REMOVED, TREES DYING, AND GROWTH OF TREES REMAINING.

	Removed, 1904.	Remaining.		Died, 1906–1910.	Increase (+) or decrease (−) in 4½ years.
		1906	1910		
					Per cent.
Number of trees	65	53	44	9	−17
Average diameter breasthigh	13 (12.8)	8.4	9.1	7.9	+ 7.7
Average height	70	60	60.3	60	+ .05
Volume (without bark) cubic feet	1,638	493	475	69	+ 3.7
Volume (mill scale) board feet	8,450	1,900	2,400	270	+26.3

AMOUNT AND GROWTH OF LOBLOLLY-PINE REPRODUCTION ON THE HALF ACRE.

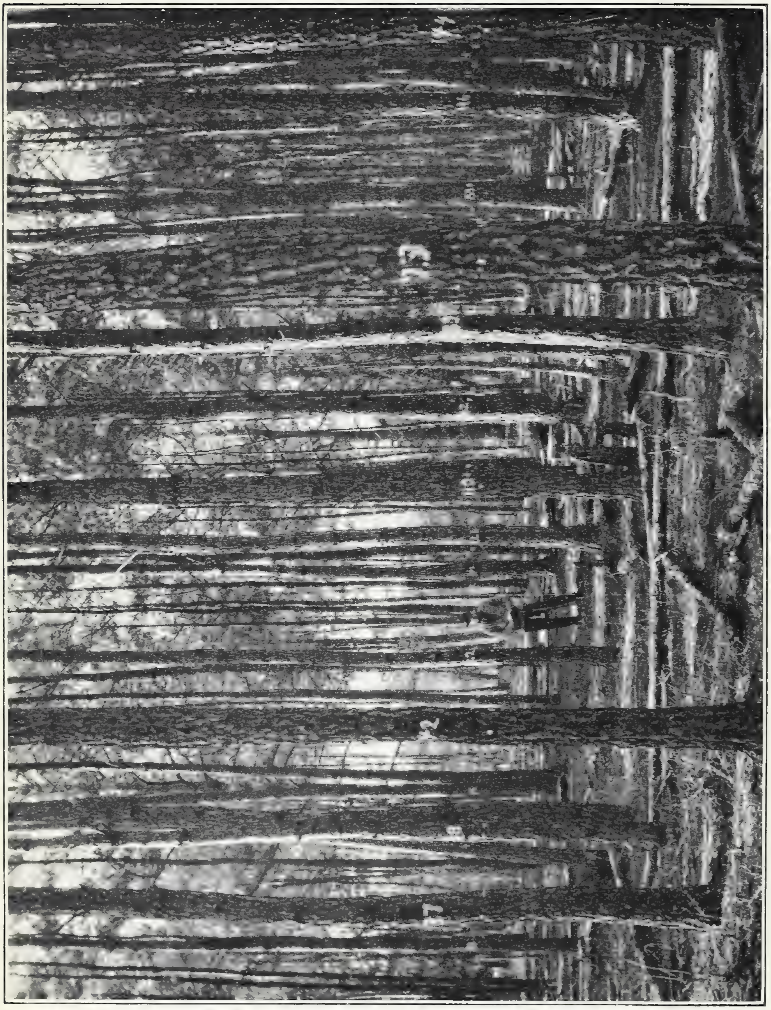
Size.	Number.	
	1906	1910
0 to 2 feet in height	720	97
2 to 4 feet in height	101	125
4 to 6 feet in height	32	203
1 inch in diameter breasthigh	8	214
2 inches in diameter breasthigh	....	62
3 inches in diameter breasthigh	....	5



A 35-YEAR-OLD FULLY STOCKED STAND OF LOBLOLLY PINE CUT TO A DIAMETER LIMIT OF 12 INCHES.

[Picture, taken 2 years after lumbering, shows adequate reproduction for a new stand to follow removal of remaining trees. Yield of this stand and size and amount of reproduction given in Table 25.]

PLATE III.



A WELL-MANAGED 23-YEAR-OLD STAND OF LOBLOLLY PINE ON QUALITY I SOIL. THINNED 5 YEARS BEFORE.

[Present yield of trees 7 inches and over in diameter breast high 10,000 board feet per acre if scaled mill cut. Since the trees are small the stand if scaled by the Doyle rule would give only 3,000 board feet per acre and by the Scribner rule 7,200 feet. Numbers painted on trees are for the purpose of identifying them in future remeasurements to determine effect of thinning.]

WORK FOLLOWING CUTTING.

The work following cutting consists in preparing the area for the reception of the seed. Frequently no work at all will be necessary.

The work which may have to be done to insure reproduction includes: (1) Brush disposal, which also serves as a fire protective measure and lessens danger from insect infestations; (2) disturbance or destruction of the forest floor, including the leaf litter and undecomposed humus; (3) destruction of ground cover and underbrush including hardwood saplings; (4) cutting of worthless trees still standing, which, preferably, should have been removed at the time of the main cutting. The amount of work to be done varies with the character of the site, whether wet or dry; with the condition of the forest floor; and with the amount and character of the ground cover and underbrush.

On moist to wet sites no work at all is usually necessary, except where there is considerable underbrush or worthless trees which it is best to cut out. The growth of loblolly-pine seedlings on such sites is hindered little or not at all by the forest floor, ground cover, and brush left after lumbering. A fire, however, to destroy all undergrowth and brush, is rather beneficial than otherwise on such sites.

On fresh to dry sites destruction of the forest floor, ground cover, and brush is advisable and often necessary to insure reproduction. The best method is to burn it. Disturbance of the forest floor during logging operations will also improve conditions for reproduction. In burning, care should be taken not to damage trees left for seed or woods adjacent to the area cut.

The time for preparing the seedbed should be governed by the occurrence of adequate seed production, preferably at the same time as the cutting if the two coincide; otherwise not until there is a good seed year.

Where the ground is in satisfactory condition for the reproduction of the seed and there are sufficient seed trees, adequate reproduction can be expected by the end of the first or second season after a good seed year.

The cost of these rough methods of preparing the ground for the reception of the seed should in no case exceed $3 per acre, and is uniformly cheaper than reforesting artificially.

REFORESTING BY ARTIFICIAL REPRODUCTION.

Where natural reproduction fails it is always possible to secure fully-stocked stands of loblolly pine by resorting to artificial reproduction. This can be done more easily and at less expense for this species than for most if not for any other species of pines in the eastern United States.

Artificial reproduction of the species may also be profitably used to stock extensive areas on which there are no loblolly-pine seed trees.

The first consideration is to determine whether to sow seed direct on the area to be reforested or whether to plant with nursery-grown or with wild-stock seedlings. The first will usually be the cheapest and therefore the best on sites to which it is adapted. Planting, however, is the surer method, and the only one to be recommended for Quality III sites and for all dry and droughty soil. Direct sowing is to be recommended only on uniformly fresh to moist soils, where it should be successful if properly carried out.

Direct Sowing.

In direct seeding of loblolly pine it is best to sow either in plowed furrows or in well-cultivated seed spots. Another method is broadcasting or scattering seed uniformly over an area, as in sowing wheat. This method is seldom if ever advisable, as it takes about five times as much seed per acre as the seed spot or furrow methods, and, to be successful, usually requires that the ground be harrowed over before and after the sowing.

If the area can be plowed the furrow method is best. Shallow furrows should be plowed from 6 to 8 feet apart, and from 10 to 15 seeds dropped in spots in the furrows at intervals of from 6 to 8 feet. Where it is impracticable to plow furrows, the next best thing is to sow from 10 to 15 seeds in well-cultivated spots 6 inches to a foot square, dug with a spade or grub hoe, and spaced from 6 to 8 feet apart each way. In each method the seed should be carefully covered with earth to a depth of not more than half an inch. Where the soil is dry and sandy, especial care should be taken to step on the spot after covering the seed, and the soil should be pressed down with the ball of the foot or else tamped with the bottom of a hoe. This will enable the seed to draw more moisture from the soil. The furrow and seed-spot methods require per acre from 6,000 to 18,000 seeds, or from one-third to one pound of seed, while for successful broadcasting from 3 to 5 pounds per acre would be necessary. When planting in furrows, it is best that these be made straight and at a uniform distance apart. When planting in seed spots, the rows can be made straight by placing upright poles on which to sight.

The best time for sowing the seed is shortly after growth ceases in the fall, but before the ground is much frozen, or as soon as the frost gets out of the ground in the spring to admit of cultivation. Loblolly seed takes from 1 to 3 months to sprout after suitable temperature conditions obtain, and often some of it holds over till the next season before germinating.

The cost per acre of sowing in plowed furrows or seed spots ranges from \$2 to \$5, depending upon cost of seed and labor, and spacing used: 50 cents to \$1.50 for seed, [1]\$1 to \$2 for cultivation, and 50 cents to \$1.50 for sowing.

PLANTING.

In planting loblolly pine it will usually be advisable to use nursery-grown stock. In some cases, however, wild stock seedlings can be advantageously used to supplement incomplete natural reproduction, as in transplanting seedlings from areas overstocked to nearby areas understocked.

The size and age of nursery stock it is best to use varies. On Qualities I and II soils 1 or 2 year old seedlings are usually successful. These can be planted either in the fall, at the end of the first or second season's growth, or set out in the spring following. On site Quality III it is always best to use 3-year-old stock which has been transplanted for two years in the nursery. It is best to use this kind of stock also on the better site qualities if there is a heavy undergrowth or growth of hardwood sprouts and seedlings with which the pine has to compete. In Quality I soils a spacing of 10 by 10 feet each way, or 436 trees per acre, is sufficient; for site Quality II, 8 by 8 feet spacing should be used, or 680 trees per acre; and for site Quality III, 6 by 6 feet, or 1,210 trees per acre. On moist to wet sites planting should not be done in the fall, unless the plants are pretty well mulched, because of the danger that the unrooted plant will be frost-thrown during the winter. On such sites spring planting is always advisable. In the fall the best time for planting is after growth has ceased; in the spring, as soon as the frost gets out of the ground.

The cost of growing loblolly pine nursery stock on a large scale [2] should be about as follows:

One-year seedlings	\$0.75
Two-year seedlings	1.25
Three-year stock (two years transplanted)	3.00

The cost of handling the stock from the nursery to permanent plantations in the forest should be about as follows per 1,000:

One-year seedlings	\$3.50
Two-year seedlings	4.50
Three-year stock (two years transplanted)	6.00

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[1] Seed to be collected by party using it. If purchased from nursery, price would be much higher.

[2] In a nursery producing 500,000 or more plants a year, as shown by the work of the P. R. R. nursery at Morrisville, N. J. For a smaller nursery the cost would be somewhat higher, although a farmer will often be in a position to collect his own seed and grow a few thousand loblolly seedlings every year in garden at practically no expense.

The cost per acre, then, of growing and setting out stock of different ages, differently spaced, would be as follows:

Kind of stock.	Spacing.		
	6 by 6 feet.	8 by 8 feet.	10 by 10 feet.
1-year seedlings	$4.99	$3.13	$2.27
2-year seedlings	6.70	4.31	3.21
3-year stock (2 years transplanted)	10.26	7.08	5.61

It will be seen from the foregoing that where wide spacing is practiced and nursery stock is grown on a large scale locally, planting can sometimes be done as cheaply as direct sowing. Moreover, it is always much the surer method. The cost figures given are, of course, only applicable to operations properly planned and skillfully carried out.

ALTERNATION OF FOREST AND FARM CROPS.

There are large areas of rather poor sandy land throughout the region in which loblolly pine occurs which will produce good farm crops for a number of years after cleared of forest and brush, but the fertility of which it is expensive to maintain for any considerable length of time. Such land can sometimes be most profitably worked on a system of alternating a forest crop of loblolly pine, grown on a 40 to 50 year rotation, with the use of the land for farm crops for a period of from 10 to 15 years. The fertilizing effect on the soil in the growing of a timber crop is in this way taken advantage of for agricultural crops. In addition to this a new crop of loblolly pine can be established very easily on the area when worn out by farming. If there are sufficient loblolly-pine seed trees in the vicinity, the reproduction will spring up naturally on the abandoned field, and if not, the pine can be planted or sowed. This is a good method of establishing a loblolly-pine forest on land which before cultivation had no loblolly on it, and also one especially adapted for use by resident farmers with woodlands adjacent to their farms.

NURSERY WORK.[1]

Where extensive planting operations are to be carried on it is best to establish a forest nursery. The following are the essential points to be held in mind in this work:

SELECTION OF NURSERY SITE.

A site should be selected if possible with a light, moderately fertile, well-drained, but uniformly fresh to moist soil, and located in the open where there will be the least danger from disturbance by birds, stock, and rodents. A small nursery can most readily be established by taking a section of a well-cultivated vegetable garden. If the soil is droughty there should be facilities for watering it in dry weather. If the ground selected has not been cultivated for some time it should be thoroughly worked, and if lacking in fertility, should be enriched.

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[1] For detailed information on nursery work the reader is referred to Bulletin 76 of the Forest Service and Yearbook Reprint 376, of the Dept. of Agriculture.

Seed Beds and Planting Seeds.

Before planting the seed, carefully prepared beds should be made, and the soil thoroughly worked, as for lettuce. Four feet wide and 24 feet long is the most convenient size for the beds. Parallel beds should be separated by walks 2 feet wide. Where the soil is light and dry, or very well drained, the beds can be on the same level with the walks, otherwise they should be elevated several inches. Planting in drills 4 inches apart, running crosswise of the bed, is the best method. By sowing 1 ounce of seed per 24 linear feet of drill, or about three-quarters of a pound per bed, it is safe to count on at least 3,000 one-year seedlings per bed, where proper attention is given to the work. This means 3,000 seedlings per 150 square feet of nursery space, including area in walks, or over 2,000,000 seedlings on a quarter acre. The seed should be sown in the spring, about the same time as early vegetables.

Care of Beds.

Beds should be kept as uniformly moist as possible, to insure germination. Ten weeks after planting most of the seeds which are going to sprout will be well up; weeding should then commence and be continued through the season. The beds should be provided with lath screens as soon as the seed is planted. These will keep the seed bed uniformly moist and secure early germination. The seedlings should be kept under partial shade the whole of the first season. Suitable screens can be made in frames "4 [1] by 12 feet, of 2 by 2 inch square sticks, across which laths are nailed, each lath alternating with an open space of the same width." These frames should be supported on posts so as to be about 18 inches above the seed bed. They should be removed only during cold, cloudy weather, when the seedlings need all the air possible to lessen the danger of their "damping off."

Transplanting Seedlings.

Where three-year-old stock is desired the seedlings should be transplanted at the end of the first season into nursery rows, spaced 4 to 6 inches apart in these, and allowed to grow two more seasons. Where two-year seedlings are desired it is unnecessary to transplant, but the amount of seed sown in the drills should be reduced one-half, so that the seedlings will have more room in which to grow. Or, instead, the seed might be evenly and thinly broadcasted over the seed bed.

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[1] From Yearbook Reprint 376, Dept. of Agriculture.

Growing Plant Stock on a Small Scale.

For the farmer who wishes to grow planting stock on a small scale the elaborate bed and its care, while the surest of success, is not altogether necessary. He can more easily establish a single row of seedlings in a fertile, well-drained section of his vegetable garden, cultivating and tending them as he would a crop of peas or beans, and without screening.

THINNINGS IN UNIFORM STANDS.

The returns possible from intermediate cuttings, or thinnings, of well-stocked uniform stands should be taken advantage of in the management of loblolly pine whenever there is a market for the material. The object of such thinnings is primarily to utilize material which otherwise would be lost through death and decay, and secondarily to improve the stand by removal of overtopped trees and some of the less desirable dominant trees, in this way concentrating the growth of the stand into a lesser number of the most desirable individuals. Where substantial returns can be realized from thinnings it amounts in effect to "eating the cake and at the same time having it," while improving its quality. Thinnings in understocked stands, which under present forest conditions are the rule, are not usually advisable.

In general, the rapidity of natural thinning, or dying out of overtopped trees, in loblolly-pine stands makes further thinning inadvisable unless the material cut can be profitably utilized.

It is best for the stand to commence thinning at an early age, that is, when 15 to 20 years old, and to repeat the thinning at intervals of from 5 to 10 years. Thinning in stands 15 to 30 years old can be made to include a larger number of undesirable trees from the dominant stand than in older stands. In the latter, thinnings should be confined almost exclusively to the removal of overtopped, unhealthy, dying, and dead trees. The thinning of loblolly-pine stands on moist to wet sites is more effective than on dry soil, because the natural dying off of overtopped trees is much slower in the former than in the latter.

Table 26 shows the increase in diameter on a wet site of a thinned as compared with an unthinned half-acre plot located in the same stand. The age of the stand in 1906, at the time of the first measurement and thinning, was 18 years, and in 1910, at the time of the second measurement, 22 years. The stand was unusually dense.

TABLE 26.—*Diameter growth due to thinning and proportion of trees cut and dying on thinned and unthinned plots. Growth in diameter on thinned and unthinned plots.*

Tree classes.[1]	Thinned plot.			Unthinned plot.		
	Total number of trees.[2]	Average diameter breasthigh.		Total number of trees.[2]	Average diameter breasthigh.	
		1906	1910		1906	1910
Dominant	195	4.6	5.8	234	4.6	5.5
Codominant	160	3.6	4.2	201	3.5	4.0
Intermediate	68	3.0	3.3	77	3.0	3.3
Suppressed	49	3.0	3.2	60	3.0	3.1
Other species	3	3.0	3.6	50	3.4	4.0
Total	474	....	....	622	....	....

[1] Under dominant and codominant are included all trees which go to form the upper or main crown cover: (1) Dominant—trees with well-formed crowns, receiving light on all sides; (2) codominant—trees with uneven crowns and crowded on the sides. The intermediate and suppressed classes include overtopped trees below the upper crown cover: (*a*) Intermediate—receiving some direct sunlight on tips of crowns; (*b*) suppressed—with tips of crowns shaded.

[2] Total number of trees alive in 1910. The average diameter given for 1906 is only for trees still alive in 1910.

Before the thinning in 1906 the thinned plot had 679 living trees and the unthinned plot 691 trees, as shown in the following classification, showing proportion of trees cut and dying:

Tree classes.	Thinned plot.				Unthinned plot.			
	Alive 1910.	Cut in 1906.	Died since 1906.	Total.	Alive 1910.	Cut in 1906.	Died since 1906.	Total.
Dominant	195	13	2	210	234	....	3	237
Codominant	160	62	8	230	201	....	21	222
Intermediate	68	33	18	119	77	....	26	103
Suppressed	49	8	25	82	60	....	17	77
Other species	2	32	4	38	50	....	2	52
Total	474	148	57	679	622	....	69	691

The beneficial result of thinning is very evident from the foregoing tables, both in the more rapid growth of the trees left in the thinned stand, and in the possible returns from the 148 trees cut in the 1906 thinning.

As a rule, thinnings in young stands 25 years or less in age should be heavy, that is, removing (1) all dead, dying, and unhealthy trees of all classes; (2) most suppressed and intermediate trees; (3) many codominant; (4) and some poorly formed dominant. In older stands as a rule only moderate thinnings should be made, removing only intermediate and suppressed trees, in addition to the dead, dying, and unhealthy of all classes.

In all thinnings two points should be aimed at: (1) To secure an even distribution of the most desirable trees with a suitable amount of growing space for each; (2) to preserve sufficient density of stand to insure pruning of lateral branches and to keep the ground fairly well shaded in order to prevent heavy undergrowth from springing up and in order to keep the soil moist. Where large gaps are formed in the upper leaf canopy by the removal of unhealthy or otherwise undesirable dominant or codominant trees healthy overtopped trees should be left to protect the soil.

Thinnings should be made in the winter, when there is the least danger from destructive insects breeding in the slash. Further to lessen danger from insects it is always best to lop the tops of the trees and burn the brush.

IMPROVEMENT CUTTINGS IN MIXED STANDS.

Improvement cuttings in mixed stands, to favor loblolly pine, will often be advisable, especially for farmers with woodlots who can work in their woodlands at spare times during the winter. They are made, as their name implies, primarily to improve the quality composition of the stand, and may be conveniently classified under (1) cutting in young sapling stands which will yield little or no usable material, and (2) cuttings in older stands where the material removed is large enough to be of some use.

Cuttings in sapling stands 5 to 10 years old should consist in weeding, or the cutting of undesirable species, and cleanings, or the cutting of inferior individuals of desirable species. These are known as disengagement cuttings, the object being to free or disengage the crowns of the more desirable trees from injurious contact with or suppression by the less desirable. This can often be accomplished by simply topping the interfering saplings individually with one slash of a brush ax or a corn knife. It is not necessary to cut back inferior trees which are not interfering with the better individuals. One man should cover from one to two acres a day in this kind of work. Scattering large trees, which have been left in previous cuttings because worthless for anything but fuel, might also be cut at the same time.

In mixed irregular stands, cut over several times but with a large number of inferior trees remaining, under which considerable sapling and small pole growth of loblolly pine and other species has sprung up, there is often an excellent chance to make an improvement cutting which will greatly benefit the loblolly. All the large inferior trees should be cut, care being taken not to damage the young loblolly pine which it is wished to favor. Sometimes, in fact, it may be best simply to girdle the large trees and leave them standing. All young growth of inferior species which is overtopping the pine should also be cut. Besides benefiting the future stand, these cuttings should at least be productive of a large amount of cordwood.

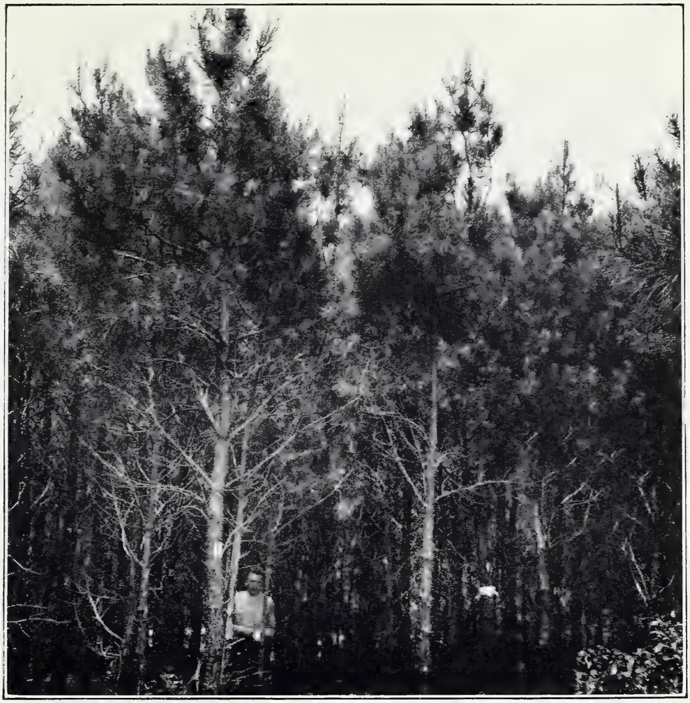

FIG. 1.—A 9 TO 10 YEAR OLD STAND NOT YET READY FOR THINNING.

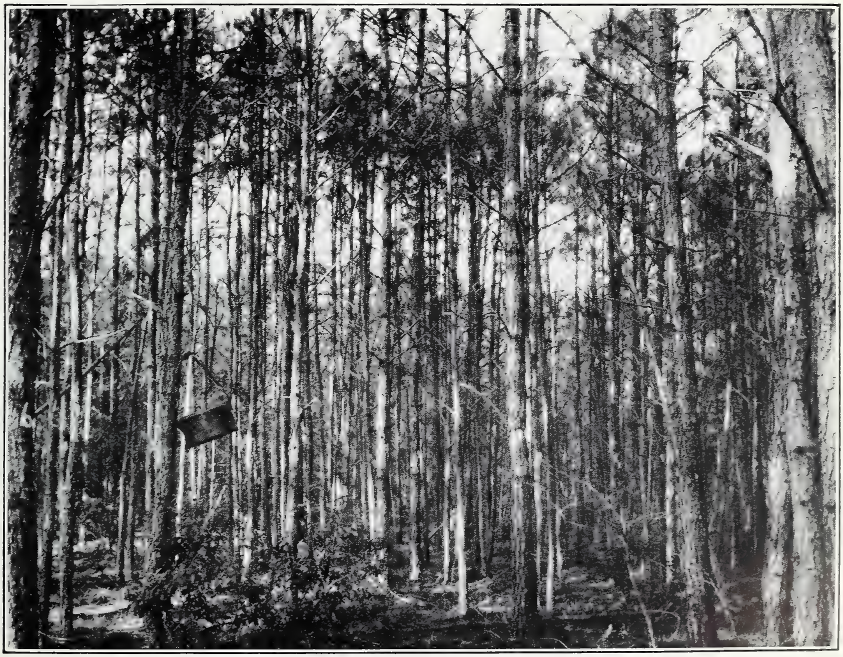

FIG. 2.—A 16-YEAR-OLD STAND READY FOR FIRST THINNING.

FULLY STOCKED YOUNG LOBLOLLY PINE STANDS.

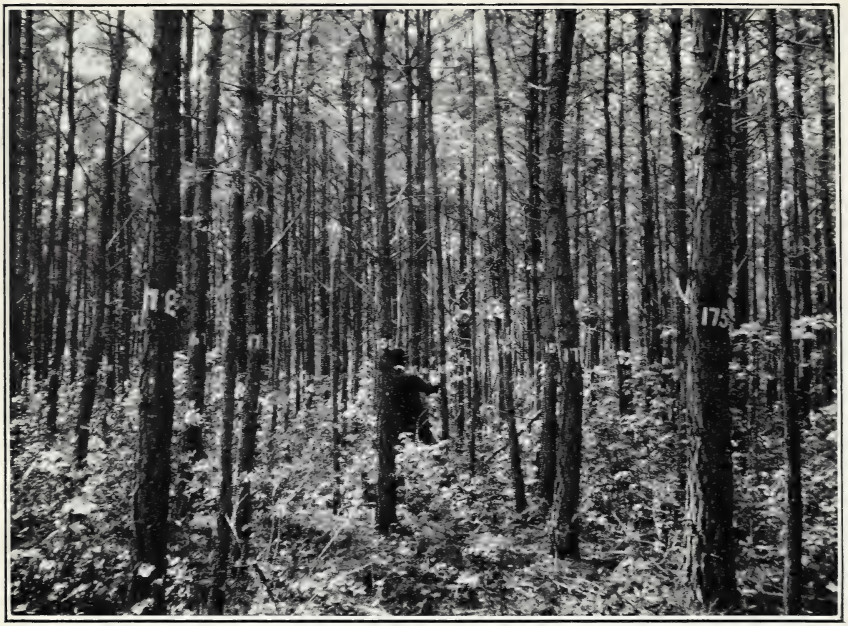

FIG. 1.—TWENTY-ONE-YEAR-OLD STAND UNTHINNED.

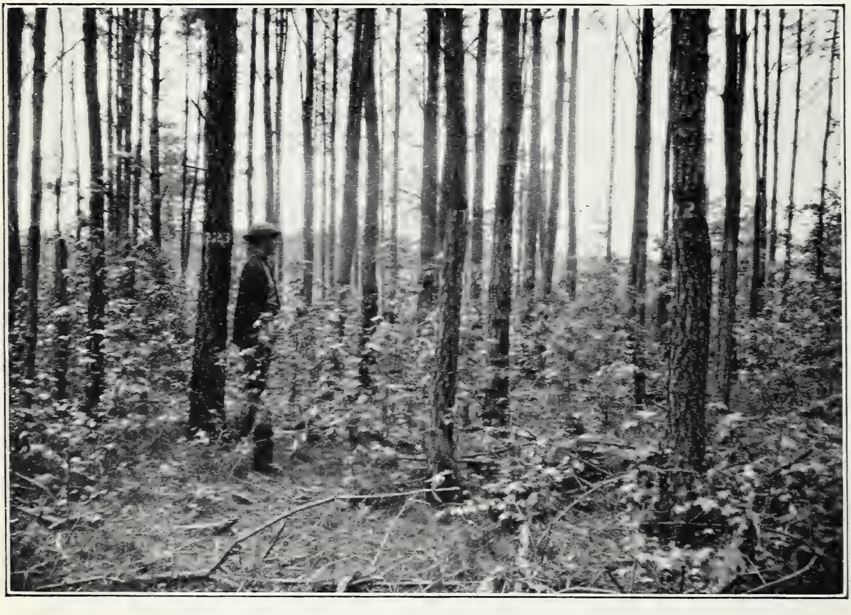

FIG. 2.—AN ADJACENT STAND OF THE SAME AGE PROPERLY THINNED 5 YEARS BEFORE, WHEN 6 CORDS PER ACRE WERE REMOVED.

THINNED AND UNTHINNED STANDS OF LOBLOLLY.

SUMMARY OF TREATMENT FOR TYPICAL STANDS.

The following is a summary of treatment to be recommended for typical existing stands in which loblolly pine occurs, the object being to favor the species and usually to make it or to maintain it as the predominating tree.

Loblolly on Moist to Wet Soils, Including Flats, Bottoms, and Swamps.

(1) *Mature stands of hardwoods with a slight admixture of loblolly pine.*—The object here should be to remove the old stand in such a way as to secure as much natural reproduction as possible of loblolly. The scattered seed tree method (as described on p. —) will be the simplest one to use, clean cutting all the hardwoods and leaving from four to six loblolly seed trees per acre well distributed over the area. Disturbance of the forest floor in logging will assist reproduction of pine. The use of fire to improve seed-bed conditions is also beneficial, but not entirely necessary. Surface burning should be carried on before the seed-fall of loblolly pine, which means any time before the first of November. Fires after seed-fall should be confined to piles of brush made in logging. Where the pine is not seeding at the time of the cutting, it will probably be better to remove the hardwoods in two cuttings, the first one opening up around the loblolly trees so as to cause them to produce abundant seed two years or so later, and a second cutting during a good pine seed year, or after the pine reproduction has taken place. The first cutting should leave enough hardwoods to keep the ground uniformly shaded, in order to prevent a luxuriance of hardwood undergrowth from springing up.

(2) *Culled-over to severely cut-over mixed hardwoods and pine, the former predominating.*—In these stands most of the mature pine has been removed, but there is often a considerable number of small pine poles and a good amount of pine reproduction, which should be favored by making general improvement and disengagement cuttings. All mature hardwoods should be cut out; all trees of undesirable species, such as red maple, mature and immature, should be cleaned out, especially where suppressing pine; sapling and small pole hardwoods of good form and desirable species should be left wherever not interfering with pine; loblolly pine should be planted or sowed in vacant spots.

(3) *Pure stands of merchantable loblolly pine on old fields or in small groups in original forests.*—Cut, using the scattered seed-tree method, or else the method of successive thinnings (see pp. 30 and 31).

(4) *Pure stands of immature loblolly pine.*—Should be thinned as recommended on pages 38 to 40.

(5) *Mixed immature stands of pine and hardwoods.*—Should be thinned as recommended on page 40.

(6) *Mixed sapling stands of pine and hardwoods.*—Give disengagement cutting, freeing the tops of the pines by cutting back hardwoods overtopping them.

LOBLOLLY PINE ON FRESH TO DRY UPLANDS.

(1) *In mixed mature stands with other pines and hardwoods, chiefly oaks.*—On light soils cut clean, leaving loblolly seed trees, as described on page 30. Burn area before seed-fall to improve seed bed. On dry heavy soils shortleaf pine should be favored in preference to loblolly, since it will reproduce better on such sites.

(2) *Cut-over mixed pine and hardwoods, with mixed reproduction.*—Clean cut all mature trees, and make disengagement cuttings favoring pine in the sapling reproduction. Plant or sow with loblolly pine any vacant places which occur on light soils, and with shortleaf pine on heavy soils.

(3) *Immature stands of pure pine.*—Thin as recommended on pages 38 to 40.

(4) *Mixed immature stands of pine and hardwoods.*—Thin as recommended on page 40.

(5) *Idle land with a dry light soil not restocking naturally to loblolly pine.*—Should be planted with 3-year-old nursery stock (2-year transplants). On dry, heavy soils it is better to use shortleaf pine.

APPENDIX A.

NOMENCLATURE.

Loblolly pine is known by a number of different names in different sections of the country, and frequently even in the same locality, according as it occurs as old growth or second growth, or in the forest or on old fields. The name "loblolly" originated in the Gulf States and was applied to a thicket swamp in which this pine is common. Below is given a list of common and local names by which the tree is known in Delaware, Maryland, and Virginia, many of which are also often applied to other species of pines.

Longleaf, longstraw, or longtag pine, applied where associated with shortleaf, pitch, or scrub pines.
Shortleaf, shortstraw, or shorttag pine, applied where associated with the real longleaf pine (*Pinus palustris*).
Swamp pine, slash pine, yellow pine, usually applied to old growth.
Rosemary pine, applied to good quality old growth.
Oldfield pine, where it occurs on old fields.
Black or black-bark pine, sap pine, bastard pine, applied to second growth.
Foxtail pine, in Maryland, common on the "western shore."
Indian pine, Virginia pine, North Carolina pine, in Virginia.
Delaware pine, in Delaware.
Maryland pine, in Maryland.

DISTINGUISHING CHARACTERISTICS OF THE TREE.

Loblolly pine is one of 13 species of yellow pine native to the eastern United States. The woods of these species are very similar, with no characteristics which can be invariably relied on for distinguishing them, yet the trees themselves have certain distinct botanical characteristics by which they can always be identified. Loblolly pine can readily be distinguished by its foliage and cones; it has a slightly glaucous foliage with three needles, from 4 to 8 inches long, occurring in a close, elongated sheath; the needles are slender, stiff, rigidly pointed, channeled, strongly keeled on the upper side, slightly twisted, and pale green in color; the cones are from 3 to 5 inches long, oblongovate to ovate and broadly conical in shape, occurring on the stem singly or in twos and threes, and nearly sessile; the cones have hard, woody scales with strong recurved prickles on the ends.

The salient characteristics of other pine associated with loblolly in the region which serve to readily distinguish them from it are as follows: Shortleaf pine (*Pinus echinata*) has straight needles (three in a sheath) 1½ to 4 inches long, and cones 1 to 2½ inches in length. Pitch pine (*Pinus rigida*) has needles more decidedly and uniformly twisted than those of loblolly, occurring three in a sheath, from 3 to 5 inches in length, while its cones are shorter, being more than 1 to 3 inches long, and uniformly ovate-conical or broadly conical in shape. Pitch pine is also apt to have bunches of needles sprouting from the clear bole of the tree, which loblolly never has. Scrub pine (*Pinus virginiana*) can be easily distinguished from loblolly by the fact that its needles occur in twos instead of threes; they have a decided twist and are from 1 to 2½ inches in length, broad and decidedly sessile on the stems. Longleaf pine (*Pinus palustris*) can never be confused with loblolly pine, on account of its extremely long needles, from 8 to 18 inches in length, while its cones are from 6 to 10 inches long.

CHARACTERISTICS OF THE WOOD.[1]

PHYSICAL PROPERTIES.

Average weight of kiln-dried wood, 31 pounds per cubic foot.

Average weight of kiln-dried wood lumber, 300 pounds per 1,000 board feet.

Specific gravity varies from 0.40 to 0.80.

Specific gravity most frequent range, 0.45 to 0.55; spring wood, about 0.40, summer wood, about 0.95; so that the weight of the wood increases with the larger proportion of summer wood.

Ash, 0.25 per cent of dry wood.

Fuel value, 73 per cent of that of white oak.

Breaking strength (modulus of rupture), 5,600 pounds per square inch, average. (77 per cent of that of longleaf yellow pine according to Sargent.)

Factor of stiffness (modulus of elasticity), 1,300,000 pounds per square inch, average. (77 per cent of that of longleaf yellow pine according to Sargent.)

Appearance of grain seen in cross section, variable, mostly very coarse; 3 to 12 rings, average 6 to the inch in structural lumber, generally wider than short leaf, which averages 12.

General character and qualities, medium heavy, strong, and tough; grain coarse, even; summer wood broad, resin more abundant than in shortleaf, but less than in longleaf; resin passages numerous, not prominent; medullary rays numerous, obscure; heartwood orange yellow to light brown, the very thick sapwood light yellow or often nearly white; not at all durable sapwood, but takes preservative treatment readily; wood of "rosemary" pine close-grained, less resinous, lighter, with much thinner sap.

SHRINKAGE AND KILN DRYING.

The wood of loblolly pine, in common with that of other of the southern pines, shrinks about 10 per cent in cross section of volume (neglecting longitudinal shrinkage) when dried from a green to an oven-dry state. From 3 to 4 per cent of this shrinkage occurs along the radius, and from 6 to 7 per cent around the circumference. In green loblolly lumber there is about 25 per cent of moisture. In the usual air-dry condition, from 12 to 15 per cent of moisture still remains in the wood, so that the shrinkage from the green to the air-dry condition is only a trifle over half of that from the green to the absolutely dry state. Wood that has shrunk will return to its original size if soaked.

The larger proportion of loblolly pine lumber is kiln dried before leaving the saw-mill yard. This drying prevents "bluing," lessens the shipping weight, and reduces the tendency to further shrinkage.

For successful kiln drying, both the wood and the water it contains should be raised to the temperature at which the drying is to take place. If the wood is slowly heated and the surface moisture carried away, the surface will become entirely dry before the interior is heated, and the lumber will shrink and check on the surface. Surface drying should be delayed in the kiln by retaining the moisture first vaporized while the heat penetrates to the interior. Steam may be used to wet the wood and raise it to the drying temperature. When the inside as well as the surface of the wood is at the proper temperature, drying may proceed, care being taken to replace the heat lost from the wood by vaporization by the heat of the kiln.

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[1] Taken from Bulletin 99 and Circular 164 of the Forest Service.

APPENDIX B.

TABLES.

CUT OF LUMBER IN THE REGION.

Table 27 gives in detail by counties the cut of lumber in the region covered by this bulletin.

TABLE 27.—*Total amount of lumber cut of all species, and the proportion of yellow pine, in counties in which loblolly pine occurs in Delaware, Maryland, and Virginia.*

[Compiled from the census returns for 1909.]

State and county.	Land area.	Total cut.	Yellow pine cut.
	Sq. mi.	*M bd. ft.*	*M bd. ft.*
Delaware	1,960	55,440	....
Kent	615	5,118	2,087
Sussex	911	46,849	36,680
Loblolly counties' totals	1,526	51,967	38,767
Maryland	9,860	267,939	....
Anne Arundel	425	2,707	1,064
Calvert	222	8,244	1,620
Caroline	320	19,017	13,334
Charles	451	8,038	2,850
Dorchester	608	20,193	16,482
Kent	281	1,474	128
Prince Georges	482	5,043	1,081
Queen Annes	376	4,518	2,383
St. Marys	372	10,904	8,507
Somerset	362	12,535	9,549
Talbot	286	6,673	3,685
Wicomico	365	24,756	22,215
Worcester	487	19,438	15,077
Loblolly counties' totals	5,037	143,540	97,975
Virginia	40,125	2,101,716	1,221,691
Accomac	478	40,403	33,196
Amelia	355	18,446	13,917
Brunswick	529	78,510	73,010
Caroline	562	28,837	25,802
Charles City	183	4,070	3,675
Chesterfield	484	39,599	35,574
Dinwiddie	521	84,138	76,006
Elizabeth City	50	....	....
Essex	277	28,331	26,318
Fairfax	433	15,413	7,541
Gloucester	253	20,623	19,508
Virginia—Contd.	*Sq. mi.*	*M bd. ft.*	*M bd. ft.*
Goochland	296	6,262	3,980
Greenesville	288	37,570	37,228
Hanover	478	17,156	13,778
Henrico	273	22,594	7,453
Isle of Wight	352	21,615	19,445
James City	159	19,603	17,633
King and Queen	336	22,259	19,669
King George	183	6,891	5,030
King William	246	2,330	2,270
Lancaster	137	10,196	8,643
Louisa	529	21,351	18,069
Lunenburg	471	48,632	37,330
Mathews	92	4,884	4,538
Mecklenburg	640	47,415	41,266
Middlesex	156	24,467	23,176
Nansemond	393	81,436	75,900
New Kent	233	18,148	16,689
Norfolk	425	139,008	120,277
Northampton	232	14,724	13,034
Northumberland	235	33,742	25,119
Nottoway	304	19,448	16,037
Powhatan	284	9,396	7,339
Prince George	302	3,059	2,016
Princess Anne	285	8,801	5,342
Prince William	353	24,074	18,081
Richmond	188	15,682	13,318
Southampton	609	95,474	78,324
Spottsylvania	401	34,466	31,995
Stafford	285	25,701	22,764
Surry	292	70,483	68,622
Sussex	490	20,486	19,162
Warwick	85	2,229	2,030
Westmoreland	245	6,381	5,347
York	134	1,020	883
Loblolly counties' totals	14,530	1,295,353	1,116,334

YIELD PER ACRE BY GRADES.

Table 28 shows the yield per acre in board feet by grades to be expected from pure, even-aged, fully stocked, unmanaged stands of loblolly pine at different ages, and on different qualities of land, when cutting all trees 5 inches and over in diameter breasthigh. Table 29 shows the same thing in per cent of grades instead of in board feet. All trees 5 and 6 inches in diameter, breasthigh, were scaled as entirely flitch, and this grade is confined exclusively to these diameter classes. The other six grades given apply to trees 7 inches and over in diameter, and comprise the main grades used by the North Carolina Pine Association in the manufacture and sale of North Carolina pine rough lumber.

TABLE 28.—*Yield per acre in board feet by grades from pure, even-aged, fully-stocked, unmanaged stands of loblolly pine of different ages.*

Age.	Flitch.	Yield per acre.							Basis.
		No. 1.	No. 2.	No. 3.	No. 4.	1 and 2 bark strips.	Box bark strips.	Total.	
				QUALITY I.					
Years.		*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Plots.*
10	1,200							1,200	7
15	3,290			188	940	94	188	4,700	17
20	3,071	166	83	913	3,237	333	498	8,300	6
25	2,178	363	363	1,815	6,050	484	847	12,100	4
30	1,272	795	636	2,703	8,586	795	1,113	15,900	2
35	591	1,379	985	3,546	11,229	786	1,182	19,700	4
40		1,904	1,666	4,522	13,566	952	1,190	23,800	2
45		2,810	2,529	5,339	15,455	843	1,124	28,100	
50		3,586	3,260	6,520	17,278	978	978	32,600	
Total									42
				QUALITY II.					
10	400							400	7
15	2,296			84	308	56	56	2,800	20
20	2,484	54	54	486	1,782	216	324	5,400	19
25	1,944	162	162	1,053	3,807	405	567	8,100	3
30	1,650	330	330	1,760	5,610	550	770	11,000	6
35	1,380	690	552	2,346	7,176	690	966	13,800	2
40	1,162	996	830	2,988	8,798	830	996	16,600	5
45	780	1,365	1,170	3,510	10,725	780	1,170	19,500	4
50		2,034	1,582	4,294	12,656	904	1,130	22,600	1
Total									67
				QUALITY III.					
10									6
15	1,131			26	91	26	26	1,300	4
20	1,904			140	560	84	112	2,800	4
25	2,332	44		352	1,320	176	264	4,400	3
30	2,460	120	60	600	2,220	240	300	6,000	
35	2,233	308	154	924	3,311	308	462	7,700	5
40	1,786	470	376	1,410	4,418	376	564	9,400	
45	1,130	678	565	1,808	5,989	452	678	11,300	1
50		1,072	938	2,412	7,638	536	804	13,400	1
Total									24

Cut by circular saw, ¼-inch kerf.

TABLE 29.—*Per cent of grades to be expected from pure, even-aged, fully-stocked stands of loblolly pine of different ages cut into North Carolina pine rough lumber.*

QUALITY I.

Age.	Flitch.	Grade.						Basis.
		No. 1.	No. 2.	No. 3.	No. 4.	1 and 2 bark strips.	Box bark strips.	
Years.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Plots.*
10	100							7
15	70			4	20	2	4	17
20	37	2	1	11	39	4	6	6
25	18	3	3	15	50	4	7	4
30	8	5	4	17	54	5	7	2
35	3	7	5	18	57	4	6	4
40		8	7	19	57	4	5	2
45		10	9	19	55	3	4	
50		11	10	20	53	3	3	
Total								42

QUALITY II.

Age.	Flitch.	No. 1.	No. 2.	No. 3.	No. 4.	1 and 2 bark strips.	Box bark strips.	Basis.
10	100							7
15	82			3	11	2	2	20
20	46	1	1	9	33	4	6	19
25	24	2	2	13	47	5	7	3
30	15	3	3	16	51	5	7	6
35	10	5	4	17	52	5	7	2
40	7	6	5	18	53	5	6	5
45	4	7	6	18	55	4	6	4
50		9	7	19	56	4	5	1
Total								67

QUALITY III.

Age.	Flitch.	No. 1.	No. 2.	No. 3.	No. 4.	1 and 2 bark strips.	Box bark strips.	Basis.
10	100							6
15	87			2	7	2	2	4
20	68			5	20	3	4	4
25	53	1		8	30	3	5	3
30	41	2	1	10	37	4	5	
35	29	4	2	12	43	4	6	5
40	19	5	4	15	47	4	6	
45	10	6	5	16	53	4	6	1
50		8	7	18	57	4	6	1
Total								24

Cut by circular saw, ¼-inch kerf.

LOG-VOLUME TABLES.

Tables 30 to 35 inclusive are log-volume tables (for logs from trees under 50 years in age), based on measurements of logs with corresponding mill tallies of lumber actually sawed out. The North Carolina measurements were taken at a mill only 5 miles from the Virginia line, and are entirely adaptable to the region under consideration.

Tables 30 and 31 show the actual mill cut in board feet and percentage of the different North Carolina Pine Association grades cut from butt, middle, and top logs of different diameters and lengths.

Table 32 is based on the cut of a portable mill in Somerset County, Md., and runs slightly higher than Table 30, due largely to the fact that the lumber was not so carefully manufactured, it being sold ungraded and mill run.

Table 33 shows the cut of small logs when sawed into crate flitch—i. e., plank 2¾-inch thick, having one waney edge. The width measured in scaling is the average width on the narrow face. A comparison of this table with the preceding (Table 32) shows that logs cut out more board feet of lumber when sawed into flitch than when sawed into boards. The value of flitch per 1,000 board feet, however, is only three-quarters that of inch lumber.

Table 34 shows the cut in board feet of flitch and of inch lumber from 4-foot logs for crate and box lumber. Measurements taken on 1 cord of stacked bolts, the diameter and amount of lumber actually cut being recorded separately for each bolt, give the following results: Bolts ranging 3 to 6 inches in diameter between bark at the small end will cut out 510 board feet of flitch per cord, or if sawed into inch boards will cut out 390 board feet; bolts 6 to 9 inches in diameter will saw out 600 board feet per cord, or if cut into inch boards will cut 500 board feet; a mill crew of four (one sawyer, one engineer and fireman combined, and two men to help in handling the bolts and the lumber) can readily saw up 5 to 10 cords a day, yielding 2,500 to 3,000 board feet of flitch, or 2,000 to 2,500 board feet of inch lumber in case sawed into the latter.

Table 35 indicates how much more lumber can be sawed from logs cut into four sections than when sawed as 12-foot logs. The percentage increase of the former over the latter is especially marked in the case of logs of small diameters, but makes little difference in large diameters.

Table 30.—*Mill cut in board feet of butt, middle, and top logs of different diameters and lengths by mill in Gates County, N. C.*

Diameter inside bark at small end.	Length of log (feet).						Basis.
	6	8	10	12	14	16	
	Volume (board feet).						
BUTT LOGS.							
Inches.							*Logs.*
4	2	3	4	5	5	6	......
5	4	5	6	8	9	10	......
6	6	7	9	11	13	15	......
7	8	11	13	16	18	21	14
8	11	15	19	23	26	30	36
9	15	20	25	30	35	40	55
10	19	25	32	38	44	50	48
11	23	31	39	47	55	62	43
12	29	38	48	57	67	76	28
13	35	46	58	69	81	92	26
14	41	55	69	82	96	110	8
15	48	64	80	96	112	128	6
16	56	74	93	111	130	149	3
Total	....	....	....	....	....	....	267
MIDDLE LOGS.							
4	2	3	4	5	6	6	......
5	4	5	7	8	9	10	3
6	6	8	10	12	14	16	19
7	8	11	14	17	19	22	44
8	11	15	19	23	26	30	54
9	15	20	25	30	35	40	61
10	19	26	32	38	45	51	37
11	24	33	41	49	57	65	24
12	30	40	50	60	71	81	18
13	36	49	61	73	85	97	8
14	43	57	72	86	100	115	5
Total	....	....	....	....	....	....	273
TOP LOGS.							
3	1	1	1	1	2	2	......
4	2	3	4	5	5	6	......
5	4	6	7	8	10	11	19
6	6	8	10	12	15	17	58
7	9	12	15	18	20	23	84
8	12	16	20	24	28	32	63
9	15	20	26	31	36	41	41
10	19	26	32	39	45	52	18
11	24	32	40	48	56	64	10
Total	....	....	....	....	....	....	293

These figures are based on straight and slightly crooked logs only.
Of the logs tallied, 65 were 12-foot, 117 were 14-foot, and 651 were 16-foot logs.
Cut by circular saw, ¼-inch kerf.

TABLE 31.—*Per cent of grades from butt, middle, and top logs of different diameters and lengths cut into North Carolina pine rough lumber by mill in Gates County, N. C.*

BUTT LOGS.

Diameter inside bark at small end.	Grade.						Basis.
	No. 1.	No. 2.	No. 3.	No. 4.	1 and 2 bark strips.	Box bark strips.	
Inches.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Logs.*
7	5.2	3.4	32.2	47.8	7.5	3.9	14
8	10.3	8.4	27.4	43.4	6.8	3.7	38
9	16.5	13.1	22.7	40.3	5.8	1.6	54
10	14.6	15.2	32.9	31.5	5.2	.6	49
11	16.6	10.0	29.0	40.0	3.5	.9	43
12	21.1	16.5	29.4	28.5	2.9	1.6	28
13	23.0	19.0	32.6	22.6	2.8		26
14	26.9	15.1	25.1	30.1	2.8		8
15	26.7	12.5	36.5	20.9	3.4		6
16	25.4	28.0	32.0	10.3	3.0	1.3	4
Total							270

MIDDLE LOGS.

5				76.6		23.4	3
6			6.1	76.9	4.6	12.4	19
7	2.8	1.1	7.8	80.7	.7	6.9	45
8	2.5	2.4	9.4	78.4	2.8	4.5	56
9	4.4	3.6	6.2	80.6	2.8	2.4	63
10	5.9	6.5	13.0	68.9	3.8	1.9	37
11	7.4	6.6	14.1	68.1	3.1	.7	23
12	8.2	10.0	16.2	63.2	1.7	.7	18
13	13.7	9.8	27.2	47.4	1.9		8
14	19.4	18.0	6.4	55.3	.9		5
15	5.7	14.5	5.5	69.1	3.6	1.6	2
Total							279

TOP LOGS.

5				79.9	2.0	18.1	20
6				93.6	.8	5.6	58
7	0.2	0.2	1.3	90.2	2.3	5.8	84
8	.5		.8	94.1	1.3	3.3	63
9	.1	.6	2.7	91.4	.2	5.0	44
10		1.5	3.2	92.6	1.1	1.6	18
11	1.0	2.4	3.4	92.1		1.1	11
12		3.5	3.8	92.7			3
Total							301

Cut by circular saw, ¼-inch kerf.

TABLE 32.—*Mill cut in board feet of butt, middle, and top logs of different diameters and lengths by mill, in Somerset County, Md.*

Diameter inside bark, small end.	Length of log (feet).						Basis.
	6	8	10	12	14	16	
	Volume (board feet).						
			BUTT LOGS.				
Inches.							*Logs.*
4	3	4	5	5	6	7	8
5	4	6	7	8	10	11	41
6	6	8	11	13	15	17	58
7	9	12	16	19	22	25	48
8	13	17	21	25	30	34	18
9	17	22	28	34	39	45	2
10	22	29	36	43	50	58	6
11	27	36	45	54	63	72	......
12	32	43	54	65	76	86	1
13	38	51	64	77	89	102	......
14	44	59	74	89	104	118	......
15	51	68	85	102	120	137	......
16	58	78	97	116	136	155	......
Total	......	......	......	......	......	......	182
			MIDDLE LOGS.				
4	2	3	4	5	6	6	5
5	4	5	7	8	10	11	18
6	7	9	11	13	16	18	59
7	10	13	17	20	23	27	39
8	14	19	23	28	33	37	9
9	18	24	30	36	42	48	4
10	22	30	37	44	52	59	3
11	27	36	45	54	63	72	......
12	32	43	54	65	76	87	1
13	39	51	64	77	90	103	......
14	45	60	75	90	105	120	......
Total	......	......	......	......	......	......	138
			TOP LOGS.				
3	1	1	1	1	2	2	1
4	2	3	4	5	6	7	37
5	5	6	8	9	11	12	39
6	7	10	12	15	17	20	10
7	11	14	18	21	25	28	1
8	14	19	24	29	33	38	......
9	18	25	31	37	43	49	......
10	23	31	39	46	54	62	......
11	28	37	47	56	65	75	......
Total	......	......	......	......	......	......	88

These figures are based on straight and slightly crooked logs only.
Of the logs tallied, 311 were 10-foot, 94 were 12-foot, and 3 were 14-foot logs.
Cut by circular saw, ¼-inch kerf.

Table 33.—*Cut of small logs when sawed into crate flitch*[1] *by mill in Somerset County, Md.*

BUTT LOGS.

Diameter inside bark, small end.	Length of log (feet).				Basis.
	6	8	10	12	
	Volume (board feet).				
Inches.					*Logs.*
4	3	5	6	7	10
5	5	7	9	10	20
6	8	10	13	15	5
Total					35

MIDDLE LOGS.

4	3	4	5	6	2
5	6	7	9	11	14
6	8	11	14	17	10
Total					26

TOP LOGS.

3	2	3	4	5	3
4	4	5	6	7	41
5	5	7	9	11	11
Total					55

[1] Sawed into flitch, i. e., plank 2¾ inches thick, having one waney edge. The width measured in scaling is the average width on the narrow side.

Cut by circular saw, ¼-inch kerf.

Table 34.—*Cut of flitch and 1-inch boards from logs of different diameters and 4 feet long by a mill in Wicomico County, Md.*

Diameter inside bark, small end.	Volume of flitch in 4-foot logs.[1]	Volume of 1-inch boards in 4-foot logs.[2]	Diameter inside bark, small end.	Volume of flitch in 4-foot logs.[1]	Volume of 1-inch boards in 4-foot logs.[2]
Inches.	*Board feet.*	*Board feet.*	*Inches.*	*Board feet.*	*Board feet.*
2.0	0.3	0.3	7.5	9.5	8.0
2.5	.8	.6	8.0	10.8	9.4
3.0	1.3	1.0	8.5	12.4	10.7
3.5	1.8	1.4	9.0	14.0	12.1
4.0	2.4	1.8	9.5	15.9	13.5
4.5	3.2	2.4	10.0	17.9	15.0
5.0	4.0	3.0	10.5	20.0	16.5
5.5	4.8	3.7	11.0	22.4	18.1
6.0	5.8	4.6	11.5	25.0	19.7
6.5	7.0	5.6	12.0	28.0	21.4
7.0	8.2	6.7			

[1] Basis, mill cut of 168 logs.

[2] Basis, mill cut of 30 logs.

Cut by circular saw, ¼-inch kerf.

Flitch is plank 2¾ inches thick, having one waney edge.

TABLE 35.—*Comparison of mill-cut logs cut into 4-foot sections and into 12-foot lengths, by mills in Somerset and Wicomico Counties, Md.*

Diameter inside bark small end.	Inch boards.		Increase (not curved).	Flitch.		Increase (not curved).
	Volume scaled as one 12-foot log.	Volume scaled as three 4-foot logs.		Volume scaled as one 12-foot log.	Volume scaled as three 4-foot logs.	
BUTT LOGS.						
Inches.	*Bd. ft.*	*Bd. ft.*	*Per cent.*	*Bd. ft.*	*Bd. ft.*	*Per cent.*
4	5	6.6	32.0	7	8.9	27.1
5	8	10.8	35.0	10	14.1	41.0
6	13	16.0	23.1	15	19.9	32.7
7	19	23.1	21.6	....	....	....
8	25	30.6	22.4	....	....	....
9	34	39.9	17.4	....	....	....
10	43	48.8	13.5	....	....	....
11	54	57.9	7.2	....	....	....
MIDDLE LOGS.						
4	5	8.4	68.0	6	9.8	63.3
5	8	10.5	31.3	11	13.7	24.5
6	13	16.0	23.1	17	19.9	17.1
7	20	21.9	9.5	....	....	....
8	28	30.3	8.2	....	....	....
9	36	38.9	8.1	....	....	....
10	44	47.9	8.9	....	....	....
11	54	57.2	5.9	....	....	....
TOP LOGS.						
3	1	4.5	350.0	5	7.0	40.0
4	5	8.3	66.0	7	11.0	57.1
5	9	12.1	34.4	11	15.5	40.9
6	15	18.0	20.0	....	....	....
7	21	26.1	24.3	....	....	....
8	29	31.2	7.6	....	....	....
9	37	39.9	7.8	....	....	....
10	46	50.0	8.7	....	....	....
11	56	59.2	5.7	....	....	....

TREE VOLUME TABLES.

Tables 36 to 44, inclusive, are tree volume tables (for trees under 50 years in age), based on the taper table (Table 45) and the log volume tables (Tables 30 to 35). Tables 36 and 38 give the volume in cubic feet of trees of different diameters and heights, with and without bark. Table 37 gives the per cent of volume subtracted for bark from the figures given in Table 36 to get Table 38.

Tables 39, 40, and 41 show the volume in board feet of trees of different diameters and heights, 39 based on actual cut of logs and trees followed through the mill, 40 based on logs and trees scaled by the Scribner log rule, and 41 scaled by the Doyle log rule. It will be seen that the mill-cut table ranges over 10 per cent higher than the Scribner rule table, and in comparison with Doyle rule table ranges 100 to 500 per cent higher on trees under 12 inches in diameter breasthigh, and 25 to 100 per cent higher on trees over 12 inches in diameter. The Doyle rule is commonly used in logging operations in southeastern Virginia, and is very much to the advantage of the mill man when cutting small trees.

Table 42 indicates the actual mill cut of small trees of different diameters and heights when cut into 4-foot lengths and sawed into flitch or into inch boards. A comparison of this table with Table 39 shows how much more lumber can be obtained when cutting small trees into very short sections.

Tables 43 and 44 show the grades of North Carolina pine rough lumber, in board feet and per cent, actually cut from trees of different diameters 30 to 50 years in age, based on measurements of logs and trees taken in the woods with corresponding mill tallies of lumber sawed out. These measurements were taken in northeastern North Carolina, 5 miles from the Virginia line.

TABLE 36.—*Volume in cubic feet, including bark, of trees of different diameters and heights, from measurements taken in Worcester and Somerset Counties, Md.*

Diameter breast-high.	Height of tree (feet).														Basis.
	15	20	25	30	35	40	45	50	55	60	65	70	75	80	
	Merchantable volume, including bark (cubic feet).														
Inches.															*Trees.*
3	0.5	0.5	0.6	0.6	0.6	0.6	......	......	......	......	......	......	......	......	3
4	.8	.9	1.1	1.4	1.5	1.7	1.8	2.0	......	......	......	......	......	......	2
5	......	......	1.8	2.1	2.4	2.7	3.0	3.4	3.7	......	......	......	......	......	9
6	......	......	2.6	3.0	3.4	3.8	4.4	4.8	5.4	5.8	......	......	......	......	62
7	......	......	......	4.0	4.7	5.4	6.1	6.8	7.5	8.1	8.8	9.4	......	......	77
8	......	......	......	5.1	6.1	7.0	8.0	8.9	9.7	10.7	11.7	12.7	13.6	......	81
9	......	......	......	......	7.0	8.4	9.9	11.2	12.5	13.7	15.0	16.2	17.3	......	47
10	......	......	......	......	......	10.5	12.1	13.8	15.3	16.9	18.5	19.8	20.9	22.0	31
11	......	......	......	......	......	......	14.2	16.3	18.3	20.2	22.0	23.9	25.7	27.5	18
12	......	......	......	......	......	......	16.3	18.8	21.2	23.6	26.0	28.1	30.1	32.1	15
13	......	......	......	......	......	......	19.6	22.6	25.5	28.0	30.4	32.6	34.9	37.0	9
14	......	......	......	......	......	......	......	26.9	29.8	32.4	35.1	37.8	40.3	42.9	2
15	......	......	......	......	......	......	......	......	32.8	36.0	39.0	42.2	45.4	48.3	5
16	......	......	......	......	......	......	......	......	......	41.0	44.4	47.8	51.1	54.2	8
17	......	......	......	......	......	......	......	......	......	47.0	50.5	54.0	57.6	61.0	1
18	......	......	......	......	......	......	......	......	......	......	56.2	60.2	64.1	67.8	1
19	......	......	......	......	......	......	......	......	......	......	61.0	65.6	70.2	74.7	1
20	......	......	......	......	......	......	......	......	......	......	......	71.7	77.0	82.4	
Total	......	......	......	......	......	......	......	......	......	......	......	......	......	......	372

TABLE 37.—*Per cent of bark in total volume of trees of different diameters in Worcester and Somerset Counties, Md.*

Diameter, breast-high.	Bark.	Diameter, breast-high.	Bark.	Diameter, breast-high.	Bark.	Diameter, breast-high.	Bark.
Inches.	*Per cent.*	*Inches.*	*Per cent.*	*Inches.*	*Per cent.*	*Inches.*	*Per cent.*
2	41	7	28	12	21	17	17
3	38	8	26	13	20	18	16
4	35	9	24	14	19	19	16
5	32	10	23	15	18	20	15
6	30	11	22	16	18		

TABLE 38.—*Volume in cubic feet, exclusive of bark, of trees of different diameters and heights from measurements of 372 trees in Somerset and Worcester Counties, Md.*

Diameter breast-high.	Height of tree (feet).										
	30	35	40	45	50	55	60	65	70	75	80
	Peeled merchantable volume (cubic feet).										
Inches.											
3	0.4	0.4	0.4	......	......	......	......	......	......	......	......
4	.9	1.0	1.1	1.2	1.3	......	......	......	......	......	......
5	1.4	1.6	1.8	2.0	2.3	......	......	......	......	......	......
6	2.1	2.4	2.7	3.1	3.4	3.8	4.1	......	......	......	......
7	2.9	3.4	3.9	4.4	4.9	5.4	5.9	......	......	......	......
8	3.8	4.5	5.2	5.9	6.6	7.2	7.9	8.7	9.4	......	......
9	......	......	6.4	7.5	8.5	9.5	10.4	11.4	12.3	......	......
10	......	......	8.1	9.3	10.6	11.8	13.0	14.2	15.2	16.1	16.9
11	......	......	......	......	12.7	14.3	15.8	17.2	18.7	20.1	21.5
12	......	......	......	......	14.9	16.8	18.7	20.6	22.3	23.9	25.5
13	......	......	......	......	......	20.4	22.4	24.3	26.1	27.9	29.6
14	......	......	......	......	......	24.0	26.1	28.3	30.5	32.5	34.6
15	......	......	......	......	......	......	29.5	32.0	34.6	37.2	39.6
16	......	......	......	......	......	......	33.9	36.7	39.5	42.2	44.8
17	......	......	......	......	......	......	......	42.1	45.0	48.0	50.8
18	......	......	......	......	......	......	......	47.2	50.6	53.9	57.0
19	......	......	......	......	......	......	......	51.7	55.6	59.5	63.3
20	......	......	......	......	......	......	......	......	61.0	65.5	70.1

Scaled to a top diameter limit of 1.5 inch inside bark. Stump height, 1 foot.
Based on taper curves, diameter measurements taken every 4 feet.

TABLE 39.—*Volume in board feet of trees of different diameters and heights based on actual mill cut in Maryland.*

Diameter breast-high.	Height of tree (feet).										
	30	35	40	45	50	55	60	65	70	75	80
	Volume (board feet).										
Inches.											
[1] 5	5	6	6	7	8	8	......	......	......	......	......
[1] 6	8	10	12	14	16	18	20	......	......	......	......
7	7	10	12	14	17	19	21	......	......	......	......
8	11	14	18	22	25	28	31	33	......	......	......
9	......	20	26	30	34	39	43	47	......	......	......
10	......	......	34	39	44	50	57	63	69	75	82
11	......	......	......	48	55	64	72	80	89	98	105
12	......	......	......	58	67	78	89	99	110	120	130
13	......	......	......	68	80	94	107	121	133	145	157
14	......	......	......	......	93	111	127	143	157	170	185
15	......	......	......	......	......	129	150	167	182	198	213
16	......	......	......	......	......	......	178	195	212	228	243
17	......	......	......	......	......	......	206	225	243	261	276
18	......	......	......	......	......	......	......	258	276	294	311
19	......	......	......	......	......	......	......	290	309	330	350
20	......	......	......	......	......	......	......	......	344	366	390

[1] Five and six inch trees scaled as if cut into flitch; i. e., plank 2¾ inches thick, having one waney edge. Width measured in scaling is the average width on narrow face. Diameter inside bark at top 3.5 inches.

Based on taper curves, scaled as 8, 12, and 16 foot logs.
Diameter inside bark of top, 4.5 inches.
Stump height assumed, 1 foot.
Circular saw, ¼-inch kerf.

TABLE 40.—*Volume in board feet of trees of different diameters and heights in Maryland, scaled by the Scribner log rule.*

Diameter breast-high.	Height of tree (feet).								
	40	45	50	55	60	65	70	75	80
	Volume (board feet).								
Inches.									
7	6	8	10	12	14	......	......	......	......
8	13	17	20	23	26	29	32	......	......
9	21	26	30	35	39	43	47	......	......
10	30	36	41	47	53	58	64	69	74
11	......	......	52	59	66	74	81	90	98
12	......	......	63	72	81	91	100	111	121
13	......	......	74	86	98	109	121	133	145
14	......	......	......	......	116	130	143	157	170
15	......	......	......	......	137	152	167	182	196
16	......	......	......	......	160	176	194	210	226
17	......	......	......	......	......	......	224	241	258
18	......	......	......	......	......	......	255	274	292
19	......	......	......	......	......	......	288	308	326
20	......	......	......	......	......	......	323	342	362

Based on taper curves, scaled as 8, 12, and 16 foot logs.
Diameter inside bark of top, 5.5 inches.
Stump height assumed, 1 foot.

TABLE 41.—*Volume in board feet of trees of different diameters and heights in Maryland, scaled by the Doyle log rule.*

Diameter breast-high.	Height of tree (feet).								
	19	45	50	55	60	65	70	75	80
	Volume (board feet).								
Inches.									
8	3	4	5	......	......	......	......	......	......
9	7	8	9	11	13	15	16	......	......
10	11	13	15	18	20	23	27	30	33
11	......	......	22	26	30	34	40	44	49
12	......	......	30	36	42	48	55	62	69
13	......	......	40	48	57	65	74	82	90
14	......	......	......	......	74	84	94	104	114
15	......	......	......	......	94	105	118	130	141
16	......	......	......	......	116	129	146	159	171
17	......	......	......	......	......	......	176	189	201
18	......	......	......	......	......	......	208	221	233
19	......	......	......	......	......	......	240	254	267
20	......	......	......	......	......	......	272	288	302

Based on taper curves, scaled as 8, 12, and 16 foot logs.
Diameter inside bark of top, 5.5 inches.
Stump height assumed, 1 foot.

TABLE 42.—*Mill cut in board feet from small trees of different diameters and heights when cut into 4-foot sections and sawed into flitch or into 1-inch boards by mills in Wicomico County, Md.*

Mill cut of trees cut up into 4-foot logs and sawed into inch boards and flitch.

Diameter breast-high.	Height of tree (feet).								
	30	35	40	45	50	55	60	65	70
	Volume in board feet, cut into inch boards.								
Inches.									
4	3	3	3	4	4	......	......	......	......
5	5	6	7	8	9	......	......	......	......
6	9	11	12	14	16	17	19	......	......
7	13	15	18	20	23	26	29	......	......
8	18	21	25	29	33	37	42	47	52
	Volume in board feet, cut into flitch.[1]								
4	4	4	4	5	5	......	......	......	......
5	7	8	9	10	12	......	......	......	......
6	12	14	16	18	20	23	25	......	......
7	17	20	23	26	30	34	38	......	......
8	23	27	32	37	42	47	53	60	67

[1] Sawed into flitch, i. e., plank, 2¾ inches thick, having one waney edge. The width measured in scaling is the average width on the narrow side.

Based on taper curves, scaled as 4-foot logs.
Diameter inside bark of top, 2.5 inches.
Stump height assumed, 1 foot.
Circular saw, ¼-inch kerf.

TABLE 43.—*Number of board feet by grades of North Carolina pine rough lumber sawed from trees of different diameters by mill in Gates County, N. C.*

Diameter breasthigh.	Height of tree.	Grade.						Total.	Basis.
		No. 1.	No. 2.	No. 3.	No. 4.	1 and 2 bark strips.	1 and 2 bark strips.		
		Volume (board feet).							
Inches.	*Feet.*								
7	47	......	......	2.5	16.7	2.0	2.7	23.9	......
8	50	......	......	6.5	19.4	2.1	3.1	31.1	1
9	54	1.3	0.9	8.4	23.5	2.3	3.6	40.0	7
10	57	2.8	2.3	9.5	30.0	2.5	4.0	51.1	45
11	60	4.8	4.0	11.4	39.4	2.9	4.3	66.8	77
12	62	7.3	6.0	14.7	52.1	3.4	4.6	88.1	65
13	64	10.8	8.6	20.8	68.0	4.0	4.7	116.9	71
14	66	15.6	12.6	28.8	84.9	4.8	4.6	151.3	55
15	68	22.5	19.1	37.3	100.0	5.5	4.4	188.8	29
16	70	30.9	25.0	45.6	112.1	6.2	4.0	223.8	29
17	71	39.8	28.2	53.7	122.2	6.9	3.5	254.3	14
18	72	49.1	29.9	62.0	131.0	7.5	3.0	282.5	6
19	74	58.3	30.9	70.6	139.0	8.1	2.4	309.3	5
20	75	67.5	31.7	79.5	146.4	8.8	1.8	335.7	1

Table 44.—*Per cent of North Carolina pine grades cut from trees of different diameters by mill in Gates County, N. C.*

Diameter breast-high.	Grade.						Volume.	Basis.
	No. 1.	No. 2.	No. 3.	No. 4.	1 and 2 bark strips.	1 and 2 bark strips.		
Inches.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Bd. ft.*	*Trees.*
7	......	......	10.4	69.9	8.4	11.3	24	......
8	......	......	20.9	62.4	6.7	10.0	31	1
9	3.3	2.2	21.0	58.8	5.7	9.0	40	7
10	5.5	4.5	18.6	58.7	4.9	7.8	51	45
11	7.2	6.0	17.1	59.0	4.3	6.4	67	77
12	8.3	6.8	16.7	59.1	3.9	5.2	88	65
13	9.2	7.4	17.8	58.2	3.4	4.0	117	71
14	10.3	8.3	19.1	56.1	3.2	3.0	151	55
15	11.9	10.1	19.8	53.0	2.9	2.3	189	29
16	13.8	11.2	20.4	50.1	2.7	1.8	224	29
17	15.7	11.1	21.1	48.0	2.7	1.4	254	14
18	17.4	10.6	21.9	46.4	2.6	1.1	283	6
19	18.9	10.0	22.8	44.9	2.6	.8	309	5
20	20.1	9.5	23.7	43.6	2.6	.5	336	1
Total.	......	......	......	......	......	......	......	405

Cut by circular saw, ¼-inch kerf.

FORM TABLE.

Table 45 shows in detail form or taper of trees of different diameters and heights and 10 to 50 years in age.

Table 45.—*Diameters at different heights above the ground of trees of different diameters and heights, from measurements taken on loblolly pine in Somerset and Worcester Counties, Md.*

30-FOOT TREES.

Diameter breast-high.	Height above ground (feet).																Basis.
	0.5	1.0	1.5	4.5	5	9	13	17	21	25	29	33	37	41	45	49	
	Diameter inside bark (inches).																
Inches.																	*Trees.*
3	3.1	2.9	2.7	2.5	2.5	2.1	1.8	1.4	1.1	0.6	0.1	.....	.....	.....	.....	....	2
4	4.1	3.9	3.7	3.3	3.3	2.9	2.5	2.1	1.6	.9	.2	.....	.....	.....	.....	....	......
5	5.2	4.9	4.7	4.1	4.1	3.7	3.3	2.7	2.0	1.2	.3	.....	.....	.....	.....	....	1
6	6.3	5.9	5.7	5.0	5.0	4.5	4.0	3.3	2.5	1.5	.3	.....	.....	.....	.....	....	1
7	7.3	6.9	6.7	5.9	5.8	5.3	4.7	4.0	3.0	1.8	.4	.....	.....	.....	.....	....	1
8	8.4	8.0	7.8	6.7	6.6	6.1	5.4	4.6	3.5	2.1	.4	.....	.....	.....	.....	....	2
Total.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	7

40-FOOT TREES.

3	3.1	2.9	2.7	2.3	2.3	2.0	1.8	1.6	1.4	1.2	0.9	0.6	0.3	.....	.....	....	1
4	4.1	3.9	3.7	3.2	3.2	2.9	2.7	2.4	2.1	1.9	1.5	1.1	.5	.....	.....	....	2
5	5.2	4.9	4.7	4.1	4.0	3.7	3.5	3.1	2.8	2.5	2.0	1.4	.7	.....	.....	....	5
6	6.3	5.9	5.7	5.0	4.9	4.6	4.2	3.9	3.5	3.0	2.5	1.8	.9	.....	.....	....	17
7	7.3	6.9	6.7	5.8	5.8	5.4	5.0	4.6	4.1	3.6	3.0	2.1	1.0	.....	.....	....	22
8	8.4	8.0	7.8	6.7	6.6	6.2	5.8	5.3	4.8	4.2	3.5	2.5	1.2	.....	.....	....	16
9	9.5	9.1	8.8	7.5	7.5	7.0	6.5	6.0	5.5	4.8	4.0	2.8	1.3	.....	.....	....	5
10	10.6	10.1	9.8	8.4	8.3	7.7	7.2	6.7	6.1	5.4	4.5	3.2	1.5	.....	.....	....	......
Total.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	68

50-FOOT TREES.

4	4.1	3.9	3.7	3.1	3.1	2.9	2.7	2.6	2.5	2.3	2.1	1.7	1.4	1.0	0.6	0.1	......
5	5.2	4.9	4.7	4.0	4.0	3.7	3.6	3.4	3.3	3.0	2.7	2.4	1.9	1.4	.8	.2	3
6	6.3	5.9	5.7	4.9	4.9	4.6	4.4	4.2	4.0	3.7	3.4	3.0	2.4	1.7	1.0	.2	39
7	7.3	6.9	6.7	5.8	5.7	5.5	5.2	4.9	4.8	4.5	4.1	3.6	2.9	2.1	1.2	.3	43
8	8.4	8.0	7.8	6.7	6.7	6.4	6.0	5.7	5.5	5.1	4.8	4.2	3.4	2.5	1.4	.3	52
9	9.5	9.1	8.8	7.6	7.6	7.2	6.8	6.5	6.2	5.8	5.4	4.8	3.9	2.9	1.6	.3	22
10	10.6	10.1	9.8	8.5	8.4	8.0	7.6	7.2	7.0	6.5	6.0	5.4	4.4	3.2	1.9	.4	15
11	11.6	11.2	10.8	9.4	9.3	8.9	8.4	8.0	7.7	7.2	6.7	5.9	4.9	3.7	2.1	.4	4
12	12.8	12.2	11.8	10.3	10.2	9.7	9.1	8.7	8.3	7.8	7.2	6.5	5.4	4.0	2.3	.5	3
13	13.9	13.3	12.9	11.2	11.1	10.4	9.9	9.4	9.0	8.4	7.8	7.0	5.8	4.4	2.6	.5	......
Total.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	181

TABLE 45.—*Diameters at different heights above the ground of trees of different diameters and heights, from measurements taken on loblolly pine in Somerset and Worcester Counties, Md.*—Continued.

60-FOOT TREES.

Diameter, breast-high.	Height above ground (feet).																							Basis.
	0.5	1.0	1.5	4.5	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69	73	77	
	Diameter inside bark (inches).																							
Inches.																								*Trees.*
6	6.3	5.9	5.7	4.9	4.9	4.7	4.5	4.4	4.2	4.1	3.9	3.6	3.2	2.7	2.1	1.6	1.0	0.4	......	......	......	......	......	5
7	7.3	6.9	6.7	5.8	5.8	5.6	5.4	5.2	5.0	4.9	4.7	4.3	3.8	3.2	2.6	1.9	1.3	.6	......	......	......	......	......	11
8	8.4	8.0	7.8	6.7	6.7	6.5	6.3	6.0	5.8	5.6	5.4	4.9	4.4	3.7	3.0	2.3	1.5	.7	......	......	......	......	......	10
9	9.5	9.1	8.8	7.7	7.7	7.4	7.1	6.8	6.6	6.3	6.1	5.6	4.9	4.2	3.5	2.7	1.8	.8	......	......	......	......	......	20
10	10.6	10.1	9.8	8.6	8.6	8.2	7.9	7.6	7.3	7.1	6.7	6.2	5.5	4.7	3.9	3.0	2.0	.9	......	......	......	......	......	12
11	11.6	11.2	10.8	9.5	9.5	9.1	8.7	8.4	8.1	7.8	7.4	6.8	6.1	5.3	4.3	3.4	2.3	1.0	......	......	......	......	......	5
12	12.8	12.2	11.8	10.4	10.4	10.0	9.6	9.2	8.8	8.5	8.0	7.4	6.6	5.7	4.8	3.7	2.5	1.1	......	......	......	......	......	8
13	13.9	13.3	12.9	11.3	11.3	10.8	10.4	10.0	9.6	9.2	8.7	8.0	7.2	6.2	5.2	4.1	2.8	1.2	......	......	......	......	......	3
14	15.1	14.3	13.9	12.1	12.1	11.7	11.2	10.8	10.4	9.9	9.3	8.6	7.7	6.7	5.6	4.4	3.0	1.4	......	......	......	......	......	......
15	16.2	15.3	15.0	13.1	13.0	12.5	12.0	11.6	11.1	10.6	10.0	9.2	8.3	7.2	6.0	4.8	3.3	1.5	......	......	......	......	......	1
16	17.3	16.4	16.0	13.9	13.8	13.3	12.8	12.4	11.9	11.3	10.6	9.8	8.8	7.7	6.4	5.1	3.6	1.6	......	......	......	......	......	......
Total	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	75

70-FOOT TREES.

Diameter, breast-high.	0.5	1.0	1.5	4.5	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69	73	77	Basis.
8	8.4	8.0	7.8	6.8	6.8	6.6	6.5	6.3	6.1	5.9	5.7	5.4	5.2	4.8	4.4	3.8	3.3	2.6	1.9	1.1	0.2	......	......	1
9	9.5	9.1	8.8	7.8	7.8	7.6	7.3	7.1	6.9	6.7	6.4	6.1	5.8	5.5	5.0	4.4	3.8	3.1	2.2	1.3	.3	......	......	......
10	10.6	10.1	9.8	8.7	8.7	8.5	8.2	8.0	7.7	7.5	7.2	6.9	6.6	6.1	5.6	5.0	4.3	3.5	2.5	1.5	.3	......	......	4
11	11.6	11.2	10.8	9.7	9.6	9.4	9.1	8.8	8.6	8.3	8.0	7.7	7.3	6.8	6.2	5.5	4.7	3.9	2.8	1.7	.3	......	......	7
12	12.8	12.2	11.8	10.6	10.5	10.2	9.9	9.7	9.4	9.1	8.8	8.4	8.0	7.5	6.8	6.1	5.2	4.2	3.1	1.9	.4	......	......	2
13	13.9	13.3	12.9	11.5	11.4	11.1	10.7	10.4	10.1	9.8	9.5	9.1	8.7	8.1	7.5	6.6	5.7	4.6	3.5	2.1	.4	......	......	5
14	15.1	14.3	13.9	12.4	12.3	11.9	11.6	11.2	10.9	10.6	10.3	9.9	9.4	8.8	8.1	7.2	6.1	5.0	3.7	2.2	.5	......	......	1
15	16.2	15.3	15.0	13.3	13.2	12.8	12.3	12.0	11.7	11.4	11.0	10.6	10.0	9.4	8.6	7.7	6.6	5.4	4.0	2.4	.5	......	......	3
16	17.3	16.4	16.0	14.1	14.1	13.6	13.1	12.7	12.4	12.1	11.7	11.2	10.7	10.0	9.2	8.2	7.0	5.8	4.3	2.5	.5	......	......	6
17	18.5	17.5	17.0	15.0	15.0	14.4	14.0	13.6	13.2	12.7	12.3	11.9	11.3	10.6	9.7	8.7	7.5	6.1	4.5	2.7	.6	......	......	1
18	19.6	18.5	18.1	15.9	15.9	15.2	14.7	14.3	13.9	13.5	13.1	12.6	12.0	11.3	10.3	9.2	7.9	6.5	4.8	2.9	.6	......	......	1
Total	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	31

80-FOOT TREES.

10	10.6	10.1	9.8	8.8	8.8	8.7	8.5	8.2	8.0	7.7	7.3	7.0	6.6	6.1	5.6	5.0	4.4	3.8	3.1	2.5	1.8	1.2	0.5	......
11	11.6	11.2	10.8	9.8	9.7	9.5	9.3	9.0	8.8	8.5	8.2	7.8	7.3	6.8	6.2	5.6	4.9	4.3	3.5	2.8	2.1	1.3	.6	2
12	12.8	12.2	11.8	10.7	10.7	10.4	10.1	9.9	9.6	9.3	8.9	8.5	8.0	7.5	6.8	6.2	5.5	4.7	3.9	3.1	2.3	1.5	.6	2
13	13.9	13.3	12.9	11.6	11.6	11.2	10.8	10.6	10.4	10.0	9.7	9.2	8.7	8.1	7.5	6.8	6.0	5.3	4.4	3.5	2.5	1.6	.7	1
14	15.1	14.3	13.9	12.5	12.5	12.1	11.8	11.5	11.2	10.8	10.4	9.9	9.4	8.8	8.1	7.4	6.6	5.7	4.8	3.9	2.9	1.8	.8	1
15	16.2	15.3	15.0	13.5	13.4	12.9	12.6	12.3	11.9	11.5	11.1	10.6	10.1	9.5	8.8	8.0	7.2	6.3	5.3	4.2	3.1	2.0	.9	1
16	17.3	16.4	16.0	14.4	14.3	13.7	13.3	13.0	12.7	12.2	11.8	11.3	10.8	10.2	9.5	8.7	7.8	6.8	5.8	4.7	3.5	2.2	1.0	2
17	18.5	17.5	17.0	15.3	15.2	14.5	14.1	13.8	13.4	13.0	12.5	12.0	11.4	10.8	10.1	9.2	8.4	7.4	6.3	5.2	3.9	2.5	1.1	......
18	19.6	18.5	18.1	16.1	16.0	15.4	14.9	14.6	14.2	13.7	13.2	12.7	12.1	11.4	10.7	9.9	8.9	7.8	6.7	5.4	4.1	2.6	1.1	......
19	20.8	19.6	19.1	17.0	16.9	16.2	15.7	15.4	15.0	14.5	13.9	13.3	12.7	12.0	11.3	10.4	9.4	8.3	7.1	5.8	4.4	2.8	1.2	1
20	22.0	20.6	20.2	17.9	17.8	17.0	16.5	16.2	15.8	15.2	14.6	14.0	13.3	12.6	11.8	11.0	10.0	8.9	7.6	6.2	4.7	3.1	1.3	......
Total	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	10

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